RUSSIAN-GERMAN COOPERATION

Laptev Sea System

TRANSDRIFT XX Expedition, March 19 – April 24, 2012

Cruise Report

H. Kassens, K. Volkmann-Lark, and the shipboard scientific party

CONTENTS

THE WINTER EXPEDITION TRANSDRIFT XX TO THE LAPTEV SEA POLYNYA

(March 19 – April 24, 2012)

Over the past decade the Arctic and the adjacent regions have been undergoing significant and sweeping changes. This includes rapidly rising temperatures, shrinking sea-ice cover, destabilization of land-fast ice, increasing coastal erosion due to permafrost degradation, changes of the ecosystem and sea-level rise. These changes have clearly manifested themselves in the shelf environments. If they continue, as predicted by climate models, they will have major consequences for the global climate through changes in ocean circulation and circumarctic ecology, as well as implications for human activities. The magnitude of the changes and the mechanisms amplifying or dampening them are still not fully investigated. It is clear, however, that they are essential for modeling and understanding the entire Arctic climate system and its feedbacks for the global system in the future.

The research within the framework of the joint Russian-German project „Laptev Sea System: the Eurasian Shelf Seas in the Arctic's Changing Environment – Frontal Zones and Polynya Systems in the Laptev Sea" focuses both on the ongoing environmental changes and on the understanding of natural variability in the Arctic and, particularly, the Laptev Sea. Polynyas are of major importance for the sea-ice production and the ecosystem of the Arctic shelf seas. These polynyas form along the coastline between fast and drift ice and are particularly sensitive to changes in the oceanic and atmospheric circulation (Fig. 1). Therefore, they provide a unique object of research into the consequences of these changes for the Arctic.

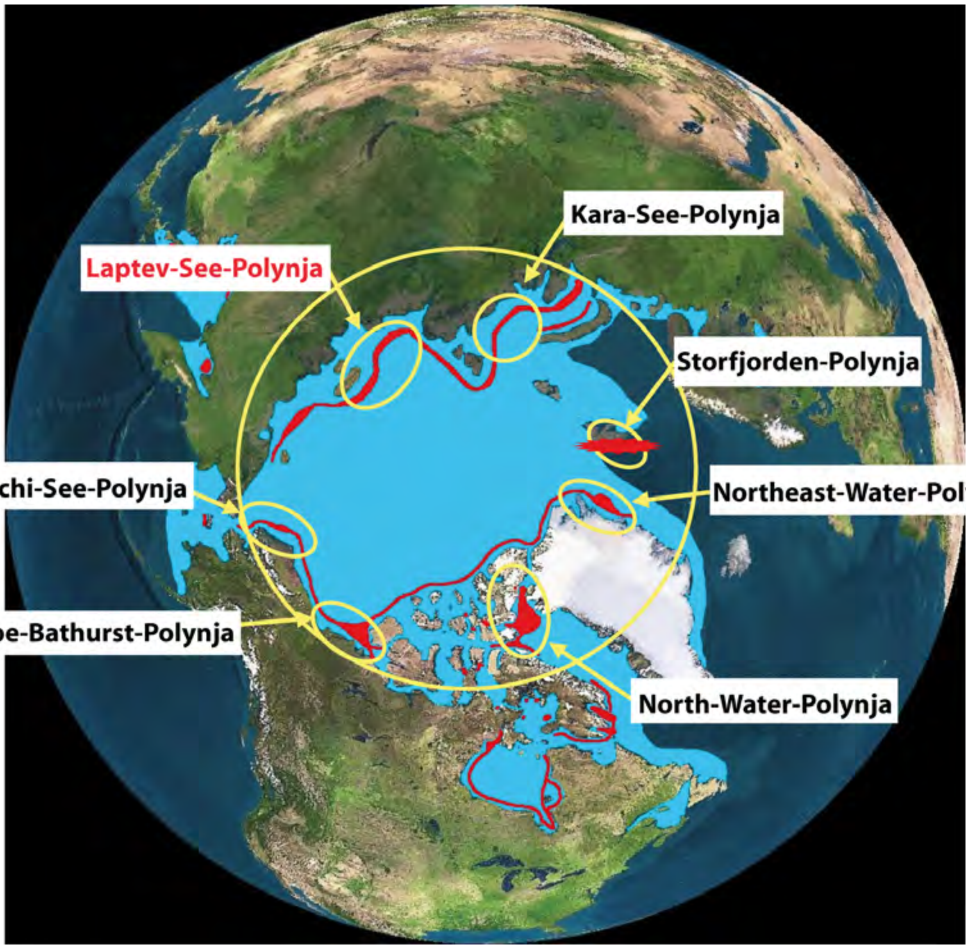


Fig. 1: The circumarctic flaw lead system

The winter expedition TRANSDRIFT XX was carried out in the second phase of the Russian-German project “Frontal Zones and Polynya Systems in the Laptev Sea II” (2010 – 2012). TRANSDRIFT XX was funded by the Russian Ministry of Education and Science, the German Ministry of Education and Research, the Russian Foundation for Basic Research, the Alfred Wegener Institute of Polar and Marine Research, the Arctic and Antarctic Research Institute, the GEOMAR Helmholtz Centre for Ocean Sciences Kiel, the Lena Delta Nature Reserve, Moscow State University, and Trier University. The working area of TRANSDRIFT XX was located east of the Lena Delta in the area of fast ice, northeast of the Lena Delta at the fast-ice edge and in the area of the Laptev Sea polynya.

The research team of the expedition comprised 17 scientists from the Alfred Wegener Institute of Polar and Marine Research, Arctic and Antarctic Research Institute, GEOMAR Helmholtz Centre for Ocean Sciences Kiel, Lena Delta Nature Reserve, Moscow State University, and Trier University (Fig. 2). The Deputy Ambassador of the Federal Republic of Germany to Moscow and the Head of the Department of Sciences and Education of the German Embassy accompanied the expedition from April 16 to 20, 2012.

Fig. 2: Scientific party of TRANSDRIFT XX in front of the Lena Delta Reserve (LDR) in Tiksi. The LDR generously allocated laboratory space, heated storage rooms, off-road trucks to reach the airport and Camp South, a meeting room and so on and so forth. The LDR also organized and provided accommodation for all participants.

The main focus of TRANSDRIFT XX was to study the following:

- How has the environmental system of the Laptev Sea changed since 2006 and will there be any lasting consequences?
- To what extent does the Laptev Sea Polynya (Fig. 3) contribute to the ice budget of the Arctic Ocean?

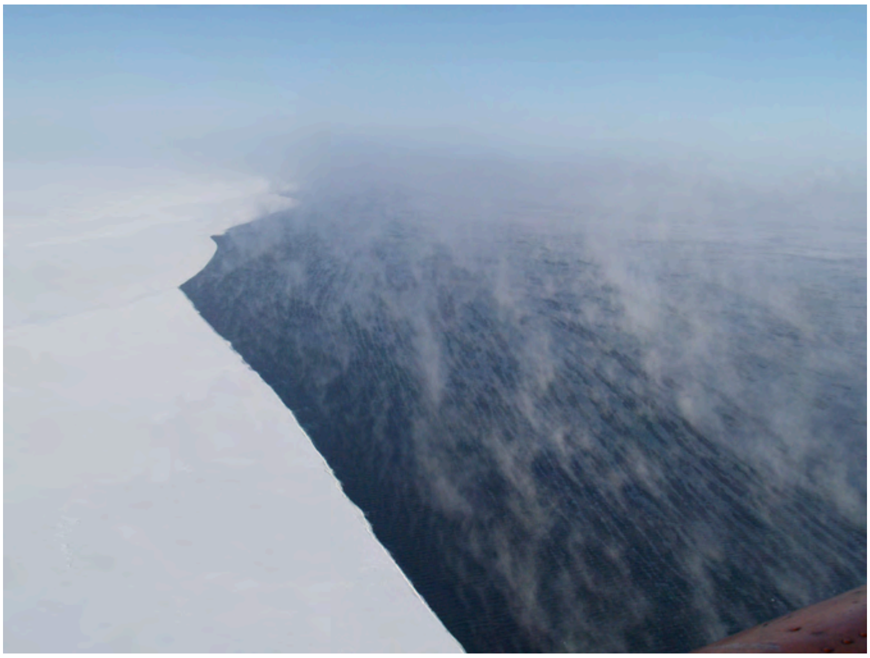


Fig. 3: The Laptev Sea Polynya at the fast-ice edge north of the Lena Delta during TRANSDRIFT XX (Camp North, Station TI12 01, 26.3.2012)

To validate satellite data with respect to the ice budget in the region of fast and thin ice, ice-thickness and sea-ice surface temperature measurements were carried out with an electromagnetic (EM) Bird during helicopter flights N and NE of the Lena Delta (Fig. 3). In addition, estimates of the polynya area, obtained from satellite images (Fig. 4), were used to quantify seasonal ice export and production rates in the Laptev Sea.

Fig. 3: For the scientific work on the fast ice and at the polynya, the expedition team used helicopters and off-road trucks. The EM-Bird is shown on the left photo.

Three ice camps were installed at the Laptev Sea polynya and east of the Lena Delta in order to obtain time series of meteorological, oceanographic, hydrochemical, and biological data (Fig. 5). Two automatic weather stations (Mishka I and Mishka II) continuously recorded air temperature, relative humidity, wind speed and direction, atmospheric pressure, and ground pressure at Camp North and Camp South.

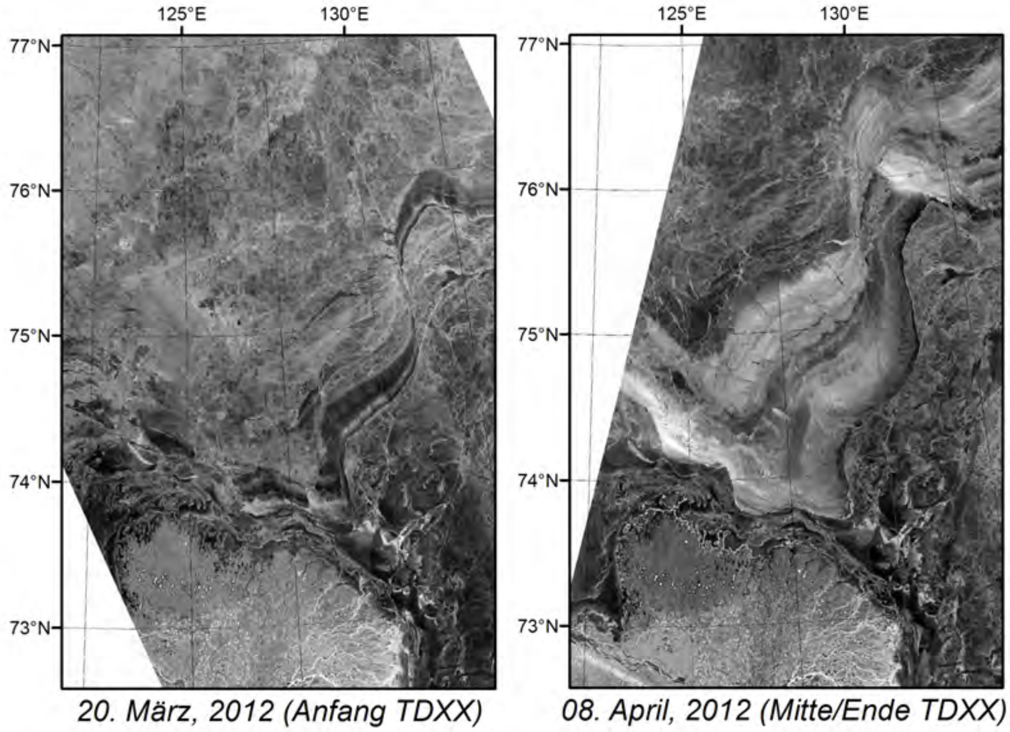


Fig.: 4: ENVISAT satellite images of the Laptev Sea Polynya during TRANSDRIFT XX. At the beginning of April, a very active and large polynya developed north of the Lena Delta.

At Camp North (Fig. 5) and Central two autonomous oceanographic moorings were deployed beneath the fast ice for four weeks and three weeks, respectively, to characterize tidal dynamics and their influence on turbulence in the water column. For the first time, a comprehensive working program was carried out at all three ice camps to study the structure and stability of fast ice.

The weather and ice conditions during TRANSDRIFT XX were excellent (Fig. 6), and all planned helicopter flight were successfully carried out. However, due to technical problems, EM-Bird flights were only possible during the second half of the expedition and only two out of three weather stations were established. Station and ice-route planning was based on ENVISAT images until April 8 (last satellite contact; end of mission) efficiently. After the contact to the satellite was lost, station planning was based unfortunately only on images received at the beginning of TRANSDRIFT XX.

The main results of the winter expedition TRANSDRIFT XX in 2012 are the following:

- a distinct decrease in the sea-ice thickness as compared to the winters of 2008 (TRANSDRIFT XIII) and 2009 (TRANSDRIFT XV) was recorded;
- a very early beginning of the spring algae bloom and the shift from a winter to a summer regime were observed;
- at the base of the fast ice along the fast-ice edge (Camp North) the zooplankton and phytoplankton concentration was very high;
- chlorophyll concentrations 10 times higher as compared to the surface water during summer were recorded at the base of the fast ice in early April;
- the spring of 2012 was characterized by a particularly high activity of the Laptev Sea Polynya and, therefore, by high ice-production rates.

With the results of the TRANSDRIFT XIII and TRANSDRIFT XV expeditions, of the seafloor observatories which were deployed in 2011, the data from remote sensing and the various interrelated models, all taken together, we have gained an insight into the mechanisms of the polynya system and their significance for ocean circulation and ice production.

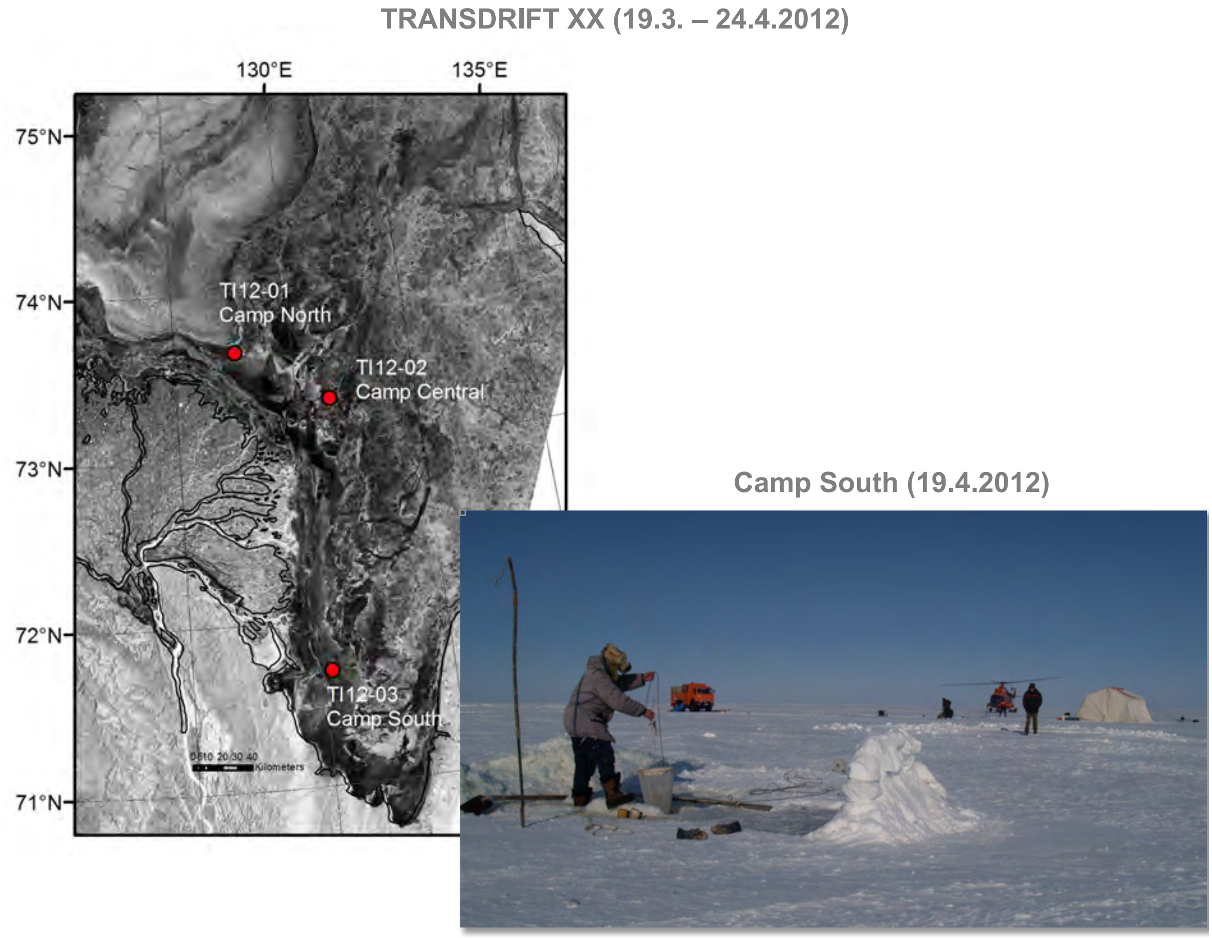
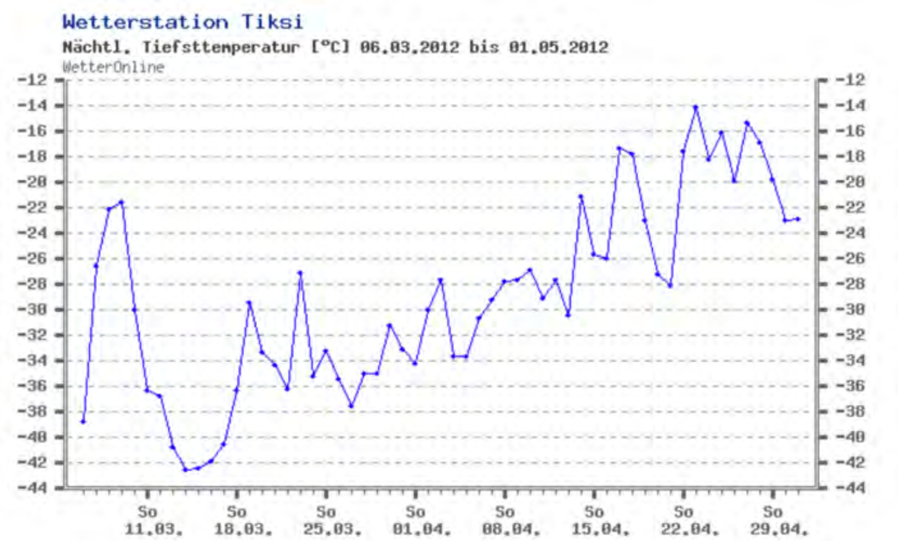


Fig. 5: Station map of the helicopter-based winter expedition TRANSDRIFT XX. The map shows the the three ice camps at the Laptev Sea Polynya and east of the Lena Delta (ENVISAT satellite image). Camp South (photo) was also the base for the 4-days truck station (TI12 03, 1.4.-4.4.2012).

This expedition would not have been possible without the support of numerous colleagues in Germany and Russia. Many thanks go to AARI, AWI, GEOMAR, the LDR, Moscow State University and Trier University for their excellent cooperation. Also we would like to thank the helicopter crews from the aviation company Polar Airlines and Tiksi Airport.

The expedition was funded by the German Federal Ministry for Education and Research (project n. 03G0759), Russian Ministry of Education and Science, the Roshydromet, the Russian Foundation for Basic Research, GEOMAR, AWI and Trier University. We wish to thank these organisations for their financial and logistic support.

Special thanks go to the German Embassy in Moscow, the Ministry of Education of Sakha Republic, the Lena Delta Nature Reserve and the town of Tiksi for their valuable support.



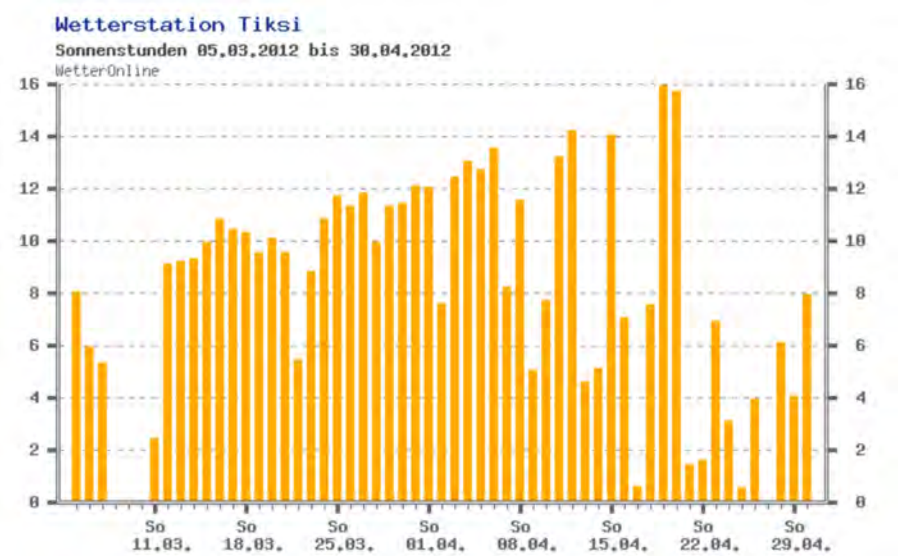


Fig. 6: Weather conditions during TRANSDRIFT XX.

DATA REPORT HEM-BIRD AND CAMERA

T. Krumpen, V. Selyuzhenok
Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Aims/objectives of EM-measurements during TRANSDRIFT XX

Given the importance of the Laptev Sea for the Arctic Ocean sea-ice budget, the aim of the EM (electromagnetic) measurements made during TRANSDRIFT XX were to determine ice thickness and production rates in the vicinity of the West New Siberian polynya and the Anabar polynya. The obtained ice information on pack ice will be used to

- calibrate and validate new satellite algorithms for the determination of thin sea ice (e.g., SMOS (Soil Moisture Ocean Salinity Satellite) ice thickness information, see Fig. 7);
- as input for model-based ice-production estimates.

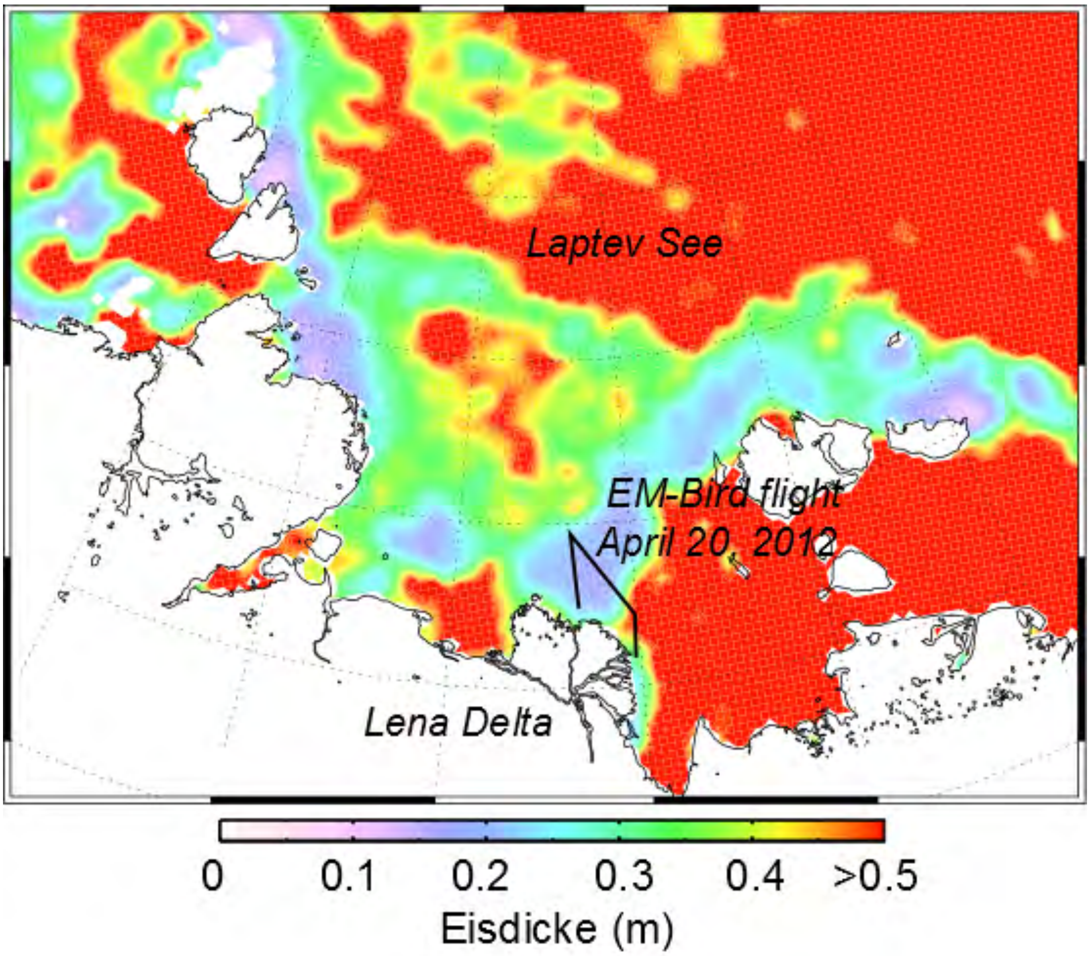


Fig. 7: SMOS ice thickness and EM-Bird pack-ice flight on April 20, 2012.

In addition, a flight over fast ice was carried out along zones of different ages of formation. The aim of this flight was to gain insight into the thickness distribution of fast ice. Information about thickness and deformation can be used to examine mechanisms that control the development and stabilization of the fast-ice zone.

Below, we summarize the datasets that were obtained during TRANSDRIFT XX and provide information about instrument configuration and detailed information on the flights.

Flight operations

All HEM-Bird and camera measurements/observations across the polynya and fast-ice area were performed between April 16 and April 20. Tracks were taken towards pre-defined points of return and back. Start and end node, the point of return and track length were chosen according to available fuel capacity, weather condition and ice condition.

In total, two flights were made. One flight over fast ice on April 16, and one over the West New Siberian polynya and the adjacent pack-ice zone on April 20, 2012. Because the HEM-Bird requires in-flight instrument drift correction, the flight tracks are divided into profiles with a length of 10 to 25 minutes. The camera was constantly taking pictures during the entire flight.

The individual profiles are presented in the chapter "Results and quzality of individual profiles". Note that during all flights, the internal EM-Bird GPS was not working. Therefore, the data were synchronized afterwards by means of a handheld GARMIN GPS.

EM-Bird principle

The EM system consists of a transmitter/receiver system for harmonic electromagnetic signals. The transmitter coil emits electromagnetic waves (primary field) at a certain frequency, which leads to induction of eddy currents in any conductive layers beneath the instrument. These eddy currents induce again an electromagnetic field (secondary field), which is measured together with the primary field by a receiver coil. Because of induction processes, the secondary field has a phase shift to the primary field. This phase shift together with the strength of the secondary field is a function of the thickness and the conductivity of layers underneath the instrument.

Due to the large conductivity contrast to the saline sea water, the air, snow and ice layers can be assumed to be electrical insulators. With a known seawater conductivity, the EM signal can be modelled as a function of height above the sea level (Fig. 8).

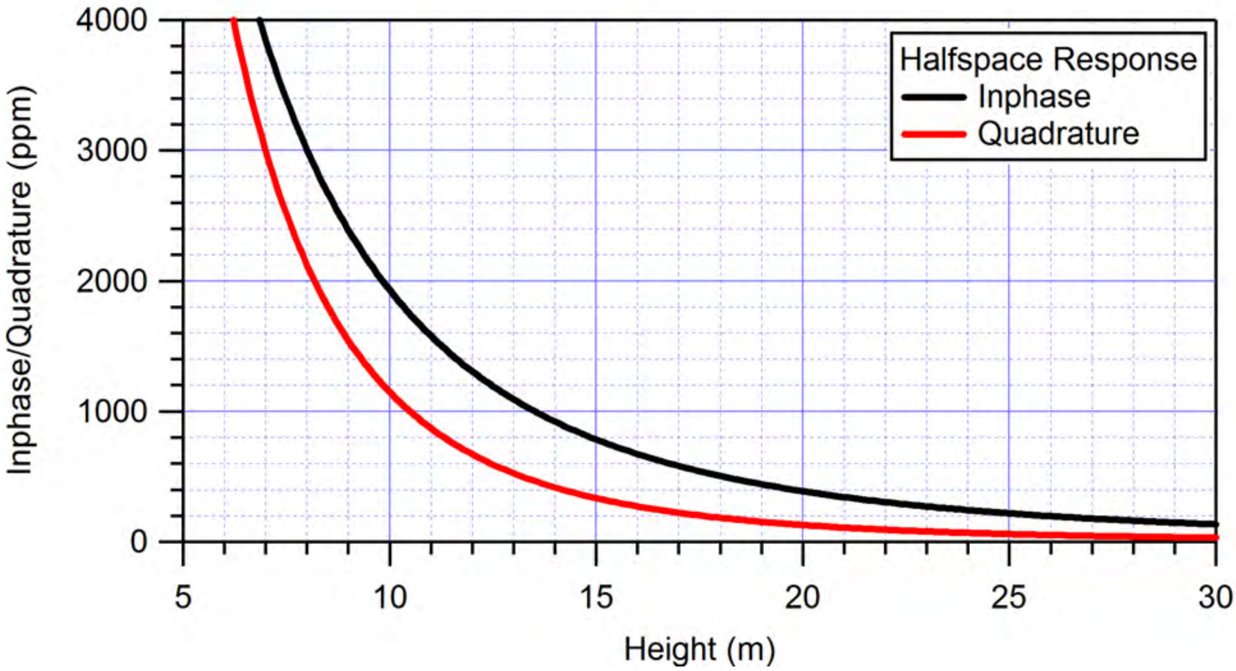


Fig. 8: Forward model results for inphase and quadrature channels (conductivity 2.500 mS/m).

While the EM system gives the distances from the instrument to the sea surface (under the sea ice) a laser altimeter records the distances to the top of the sea-ice or snow layer. The snow plus ice thickness is equal to the laser range minus the EM-derived distance.

Salt water conductivity

Information on salt water conductivity for EM-data processing can be obtained from the oceanographic dataset collected during TRANSDRIFT XX.

Camera system

All aerial pictures were taken with a GPS-compatible Ricoh© Caplio camera. The external GPS antenna was placed outside the helicopter, approximately 1.8 m away from the image centre point. The GPS position was taken every second. GPS-heights (hGPS) were corrected using the Bird laser altimeter (hLaser) plus rope length (approx. 29 m). The used zoom focal length was 5.8 mm. The 35 mm equivalent is 28 mm with a view angle of 46.4° (β-vertical) x 65.5° (α-horizontal). After defining the image corner coordinates, the photographs were georeferenced to a stereographic coordinate system using a cubic convolution methodology.

EM-Bird data structure

The EM-Bird data have not been processed yet. It is planned that ice-thickness information obtained on a specific date will be stored in an ascii file. The file name consists of the date (e.g., 20110719) and an "_allfinal.dat" extension.

A single data take (row) includes the year (1st column), the month (2nd column), the day (3rd column), the FID (file indicator; 4th column), latitude (5th column), longitude (6th column), distance from FID 0 (7th column), ice thickness (8th column) and instrument height above ice (9th column).

The camera was mounted in portrait mode with GPS (internal) towards flight direction. GPS information comes from an external antenna mounted on the left side of the helicopter. The camera itself was mounted on a gimbal. GPS information for image registration is stored in the EXIF header. Below, a subset of available image information is given:

R0013986.jpg - EXIF Information

- Exif

Image Description	
Make	RICOH
Model	Caplio 500SE
Orientation	top, left side
X Resolution	1/72 inches
Y Resolution	1/72 inches
Resolution Unit	Inches
Date/Time	2012:04:20 03:47:57
YCbCr Positioning	Datum point
Copyright	(C) Caplio 500SE User
Exposure Time	1/710 sec
F-Number	F4,7
Exposure Program	Program normal
ISO Speed Ratings	64
Exif Version	2.21

Date/Time Original	2012:04:20 03:47:57
Date/Time Digitized	2012:04:20 03:47:57
Components Configuration	YCbCr
Compressed Bits Per Pixel	1.6 bits/pixel
Aperture Value	F4,6
Brightness Value	7.8
Exposure Bias Value	0
Max Aperture Value	F2,4
Metering Mode	Multi-segment

Results and quality of individual profiles

Below, information about flight conditions, data coverage and the quality of HEM-Bird, laserscanner and camera data is given.

April 16, 2012

The first fast-ice flight was performed on April 16, 2012. Figure 9 shows the flight tracks, the individual waypoints (WP) and legs. Instrumentation and data quality for the flight are presented in Table 1.

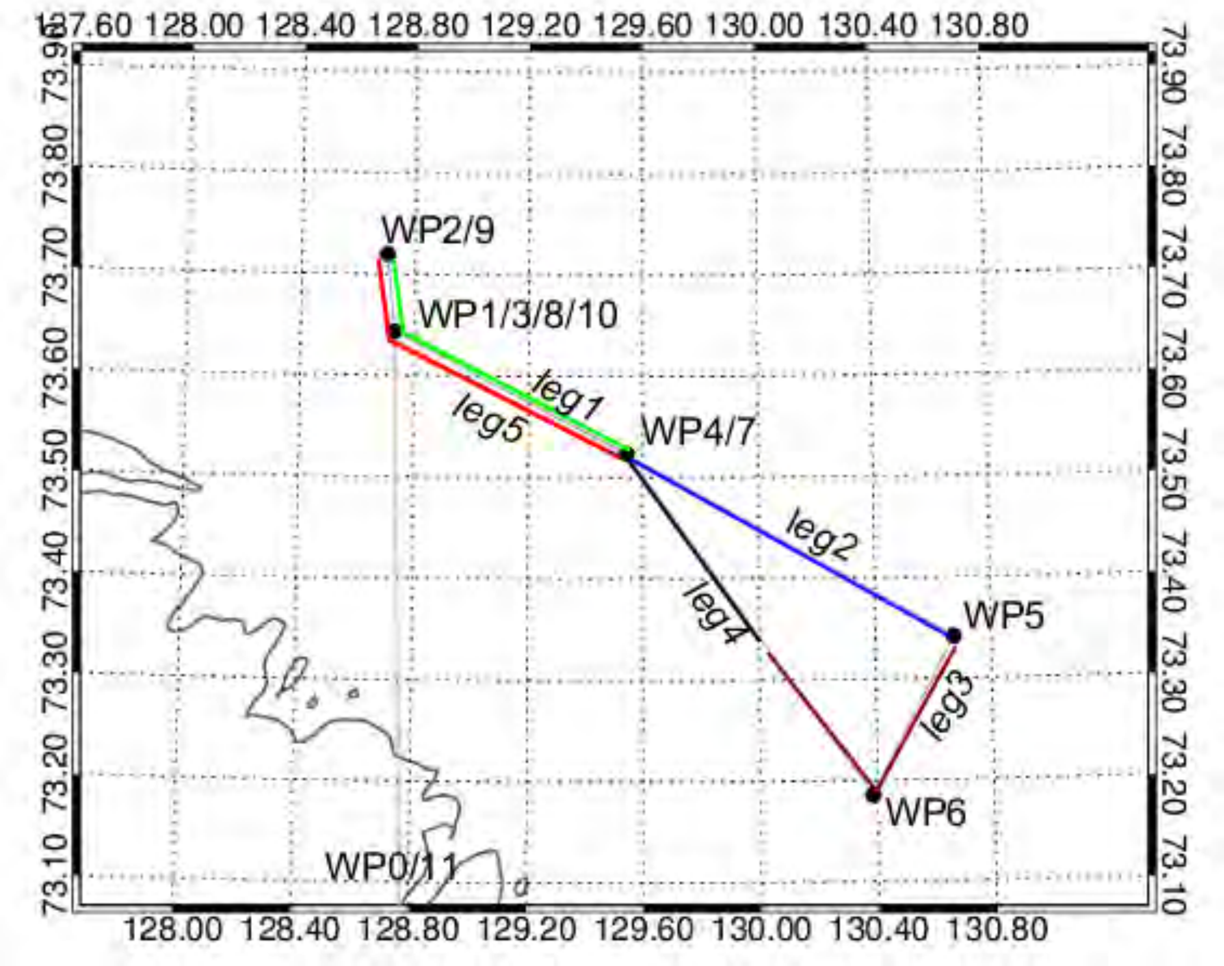


Fig. 9: Fast ice thickness survey on April 16, 2012.

Table 1: Instrumentation and data quality for the flight on April 16, 2012

Leg	Notes
Leg 1 Start: 03:15:06 (UTC) End: 03:44:35 (UTC)	Flight starting near WP2 (coming from WP1 und and going back to WP3 and WP 4 finally). When passing over the fast ice edge, pilots were confused by laser failures over open water (first events set) so that flight height was changed to above 70 feet. In addition, flight speed was too low in the beginning (80 km/h). This was noticed too late so that 2 zero measurements at 400 feet had to be made to make sure that profile ends at WP 4. When passing WP 3 (Camp North) and WP 4 (side of fuel deposit) event was set because reference measurements are available at those positions.
Leg 2 Start: 03:45:00 (UTC) End: 04:10:02 (UTC)	Leg 2 started at WP 4 by repeating the flight over reference measurements made near the fuel deposit. When passing, event was set. Then heading towards WP 5. Here are also reference measurements available (compare with Camp Central).
Leg 3 Start: 04:10:20 (UTC) End: 04:35:16 (UTC)	Leg 3 started at WP 5. Reference measurements (Camp Central) were repeated after flying a loop and can be used for comparison. When passing, event was set. Then heading towards WP 6. At WP 6 zero measurements were made. The profile ended half way between WP6 and WP7.
Leg 4 Start: 04:36:00 (UTC) End: 04:47:40 (UTC)	Leg 4 starts half way between WP6 and 7 and ends at WP 7 with a flight over the reference measurements made near the fuel deposit. Event was set. No zero measurements were made, owing to absence of strong instrument drift. Eventually pilots were too high when passing over WP 7.
Leg 5 Start: 04:48:00 (UTC) End: 05:10:00 (UTC)	Leg 5 starts with a second flight (after a loop) over WP 7. Again, pilots were too high, before and after passing WP 7 (fuel deposit station). Zero measurements were made half way between WP 7 and WP 8 (Camp North). At WP 8, we covered flags (event was set) and continued towards WP 9 (polynya edge), where flight ended over open water. Then we returned to WP 10 without measuring.

The EM-Bird internal GPS was not working during the entire flight, but aerial pictures were taken in 30-sec. intervals. WP 3, 4, 5 and 7 were covered twice in a loop to make use of ground reference measurements.

The weather was partially cloudy with strong winds.

April 20, 2012

Blue sky and temperatures around -20°C in the morning near Tiksi made a long flight across the polynya towards the pack ice possible. Weak winds from east and northeast ensured stabile flight conditions. The EM-Bird was warmed up during the helicopter flight out to WP 1. The system was driven by batteries due to poor helicopter power supply. The fast-ice temperatures were around -16°C. Note that the GPS was not working during the entire flight. Aerial pictures were taken in 30-min. intervals, together with KT15 surface temperatures.

Figure 10 shows the flight tracks, the individual waypoints (WP) and legs. Instrumentation and data quality for the flight are presented in Table 2.

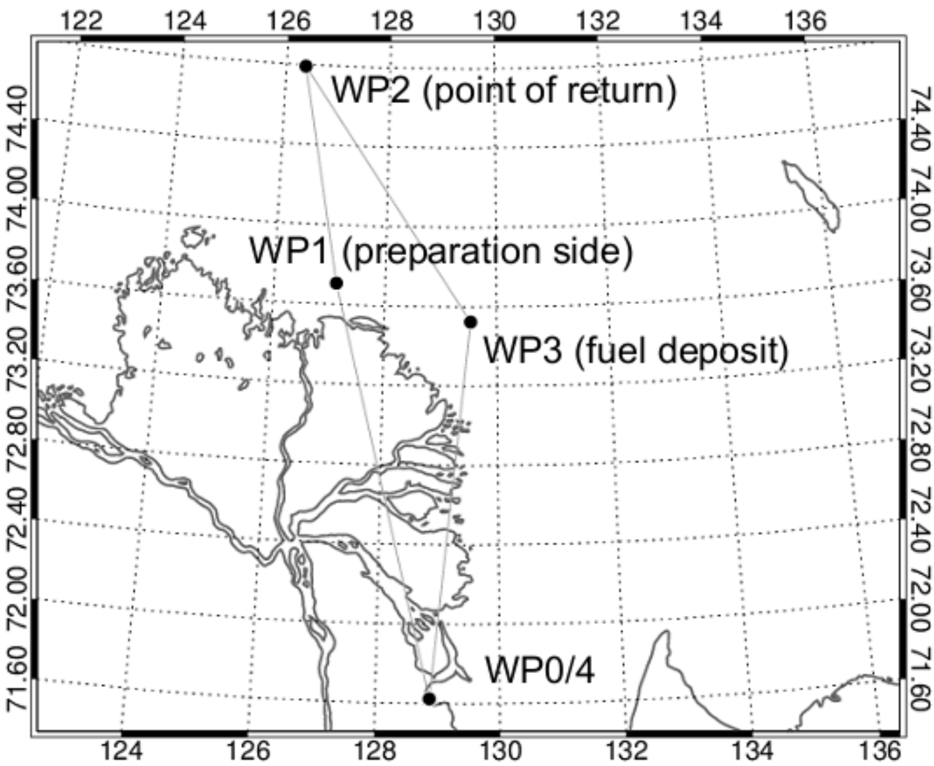


Fig. 10: Pack ice thickness survey on April 20, 2012.

Table 2: Instrumentation and data quality for the flight on April 20, 2012

Leg	Notes
Leg 1 Start: 02:57 (UTC) End: 03:25:30 (UTC)	Flight started at WP 1 after instrument warm-up on ground and during flight to WP 1. First part (6 km) covers fast ice, until fast-ice edge was reached. For fast ice, no reference measurements are available, but profile can be compared to earlier fast-ice measurements (check flight on April 16, 2012). The polynya area started with an open-water zone (100 m only), followed by an extensive thin-ice area with snow cover being slightly rafted. Events were set at very thin ice (less than 5 cm) instead of open water.
Leg 2 Start: 03:26 (UTC) End: 03:49:15 (UTC)	At the end of first half (before zero measurements) a bit thicker ice was present, still followed by leads, partially refrozen. At the beginning of second part, one short lead with open water (event set: 32-34). All in all, a bit thicker ice with wide leads covered with very thin ice.
Leg 3 Start: 03:49:45 (UTC) End: 04:15:15 (UTC)	At the beginning of leg 3, thicker ice, with leads, covered with thin ice. Some ridges also present. A long lead (Event 36-62) with very thin ice (less than 10 cm). More leads and thin ice further north. KT15 temperatures around -6°C. Rest of the first part is dominated solely by very thin ice. Second part of the leg covers ice that looked thicker.
Leg 4 Start: 04:15:30 (UTC) End: 04:39:30 (UTC)	All events set during the leg 4 refer to very thin ice only. Leg shows some thicker ice that, however, still shows finger-rafting features and temperatures around -14°C.
Leg 5 Start: 04:39:45 (UTC) End: 05:02:10 (UTC)	One event was set with little bit of open water. Ice thickness between 20 and 30 cm. At events 152, and 143 and 144 little leads with thin ice (less than 10 cm)
Leg 5 Start: 05:05:00 (UTC) End: 05:28:15 (UTC)	See leg 5. Fast-ice edge at event FID 146-155. First part of fast ice was dominated by very thin ice. Profile ended at the flag of the reference station (fuel deposit with 1.15-m-thick ice). Salinity at this position was around 16.4.

ICE-SURFACE TEMPERATURE MEASUREMENTS: DATA REPORT KT15

V. Selyuzhenok, T. Krumpen
Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Infrared radiation pyrometer KT15

The infrared radiation pyrometer KT15 receives the infrared radiation emitted by the measured surface. If the emissivity of the surface is known, its temperature can be determined. The instrument was used to measure the temperature of pack and fast ice from the helicopter. The used model of the pyrometer (KT15.85 II) is capable to measure temperature up to -50°C.

The following instrument settings were used for all measurements: measurement frequency – 1Hz, emissivity – 1.000, and time – UTC.

The pyrometer was mounted outside the helicopter/in the helicopter hatch approximately in nadir view. In order to obtain georeference information, a handheld GARMIN GPS was used. An external GPS antenna was mounted outside the helicopter (left side in flight direction).

Flight operations

All in all there were three KT15 flight operations during the expedition: April 12, April 16, and April 20, 2012. A flight with single KT 15 measurements was made on April 12, the other two operations were accompanied by HEM (helicopter electromagnetic)-Bird measurements. Flight tracks for the last were chosen on the basis of HEM-Bird requirements.

KT15 data structure

The obtained data is stored in txt format. The file name contains the date of the operation. The raw measurements were synchronized with GPS information and stored under the same file name and a postfix *_geo.txt*.

A single data take (row) includes the latitude (1st column), longitude (2nd column), helicopter height (3rd column) and measured temperature (°C; 4th column).The surface temperature was plotted along the flight track and stored in postscript format.

During the operations on April 16 and 20, the battery of the pyrometer needed to be exchanged. Therefore there are two data files for each of the flights. The first and second files of the record are named using the postfixes *_1* and *_2*, respectively.

Results and quality of individual profiles

<u>April 12, 2012</u>

The aim of the flight was to measure the ice-surface temperature over the fast ice starting from WP1 and going southward to WP2 (Table 3).

Table 3: Coordinates of waypoints (April 12, 2012)

	Longitude (E)	**Latitude (N)**
WP1	130°40’14’’	73°20’30’’
WP2	130°00’00’’	73°00’00’’

The KT15 was mounted outside the helicopter. The record started before take-off. During the take-off, the temperature measurements were affected by the helicopter activity. Therefore, the first 10 min of the record should be excluded from the analysis. Flight track and temperature record are shown in Figure 11.

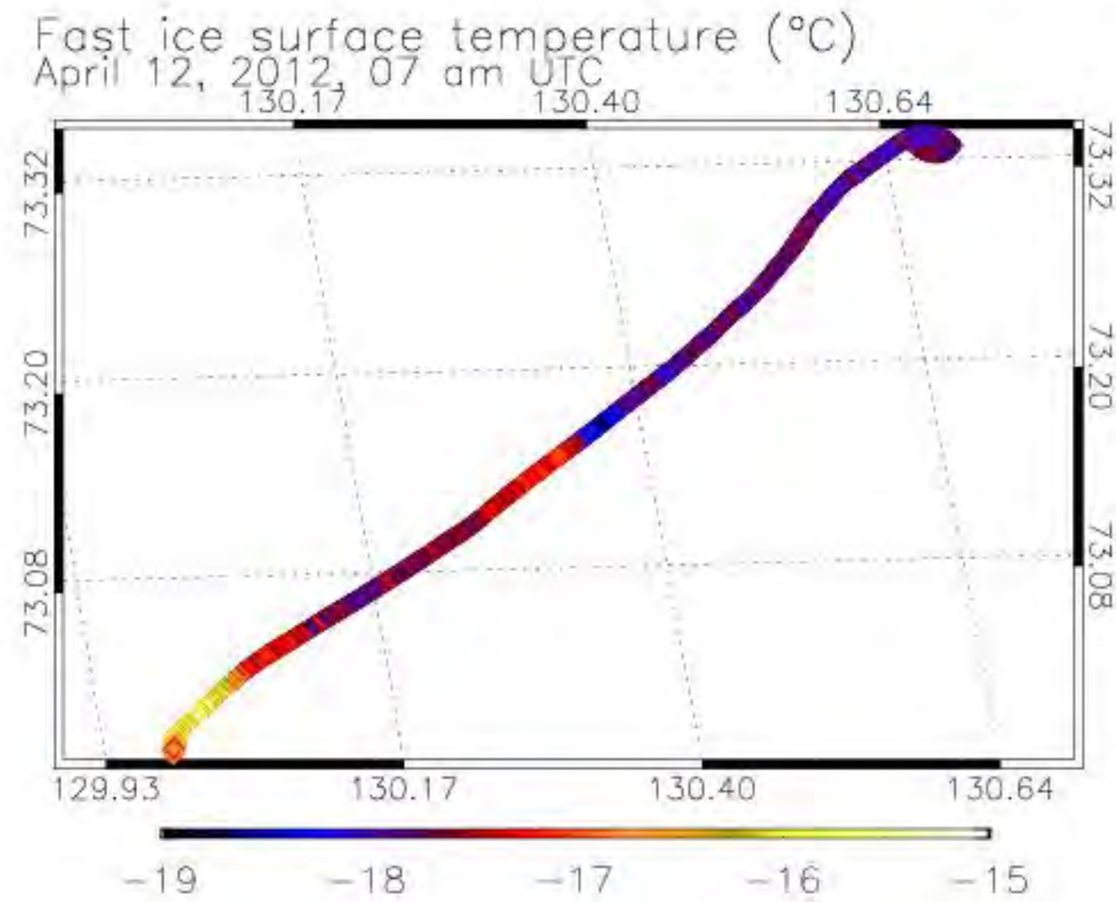


Fig. 11: Ice-surface temperature plotted along the flight track, April 12, 2012.

The weather conditions were stable – clear sky with high-level clouds.

<u>April 16, 2012</u>

The aim of the flight was to measure the temperature over the fast ice starting from the polynya edge going southwards. The measurements were made along the transect WP1-WP2-WP3-WP4-WP5-WP6-WP7 (Table 4). During the flight, KT15 measurements, EM-Bird measurements and aerial pictures were taken. The KT15 was mounted next to the camera, in the helicopter hatch.

Because of low capacity, the battery of the device was changed. This resulted in a short (interruption several minutes) of the measurements. The dataset consists of two files due to this reason. The two parts of the flight track are shown in Figure 12.

The weather conditions changed several times during the flight – from high clouds to foggy conditions. Wind speed was high.

Table 4: Coordinates of the transect on April 16, 2012

	Longitude (E)	Latitude (N)
WP1	128°43'40"	73°38'35"
WP2	128°42'06"	73°43'11"
WP3	128°43'40"	73°38'35"
WP4	129°32'15"	73°31'30"
WP5	130°40'14"	73°20'30"
WP6	130°23'09"	73°11'08"
WP7	129°32'15"	73°31'30"

April 20, 2012

The aim of the flight was to measure the temperature over the pack-ice area starting from the polynya edge going northwards and, after 120 km, turning back towards the fast-ice edge. A small area of fast ice was also covered with measurements. The measurements were made along the transect WP1-WP2-WP3 (Table 5). Flight track and temperature record are shown in Figure 13.

Table 5: Coordinates of the transect on April 20, 2012

	Longitude (E)	Latitude (N)
WP1	127°07'21"	73°42'27"
WP2	126°22'23"	74°47'32"
WP3	129°32'15"	73°31'28"

KT15 and HEM-Bird measurements as well as aerial pictures were taken during the operation. The KT15 was mounted in the helicopter hatch next to the camera.

During the flight, the battery of the pyrometer was empty and needed to be replaced. Therefore, there are two separate records covering one flight. Simultaneously the GPS device was exchanged. So the GPS track data of the flight is also divided into two parts.

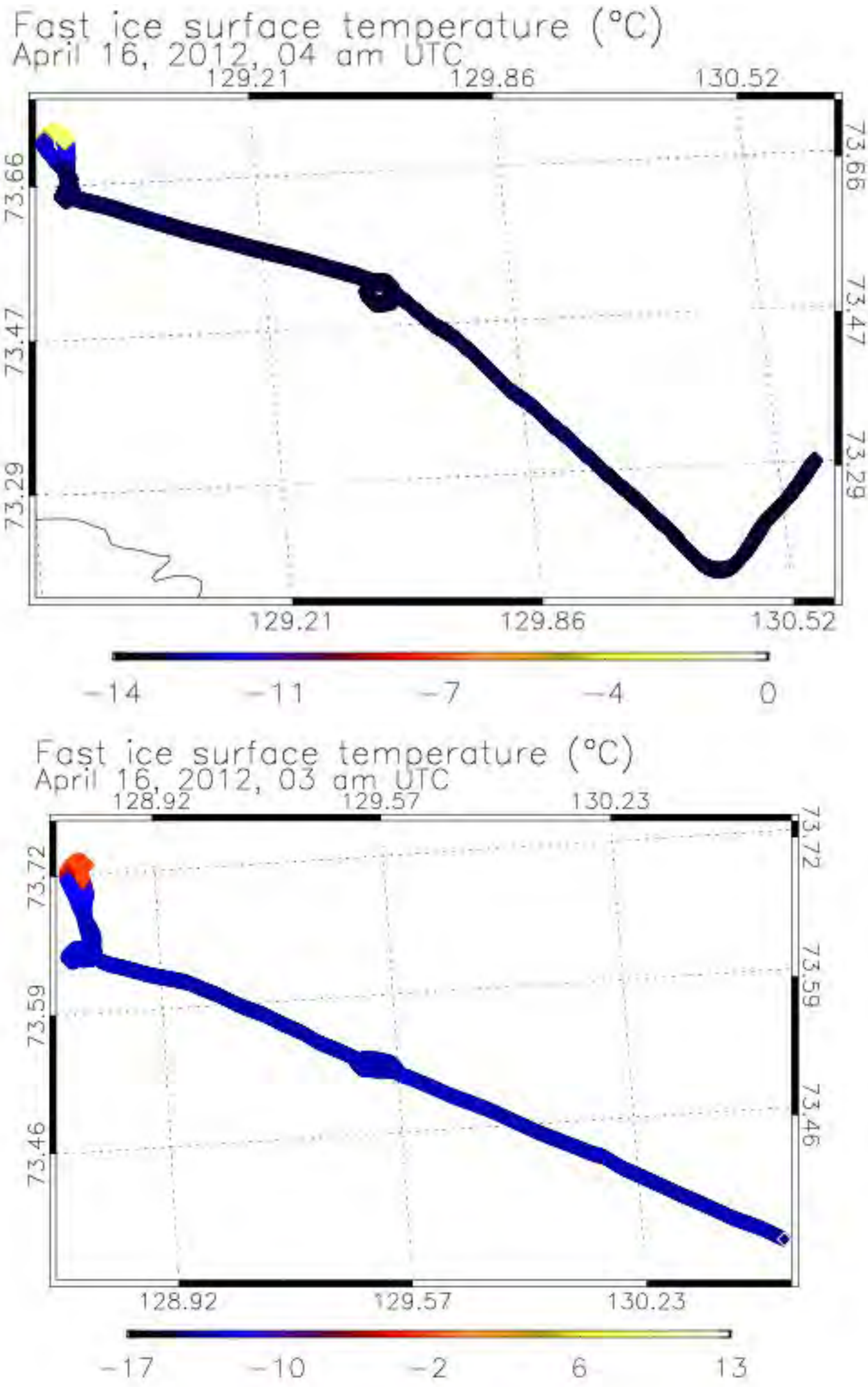


Fig. 12: Ice-surface temperature plotted along the flight track, April 16, 2012.

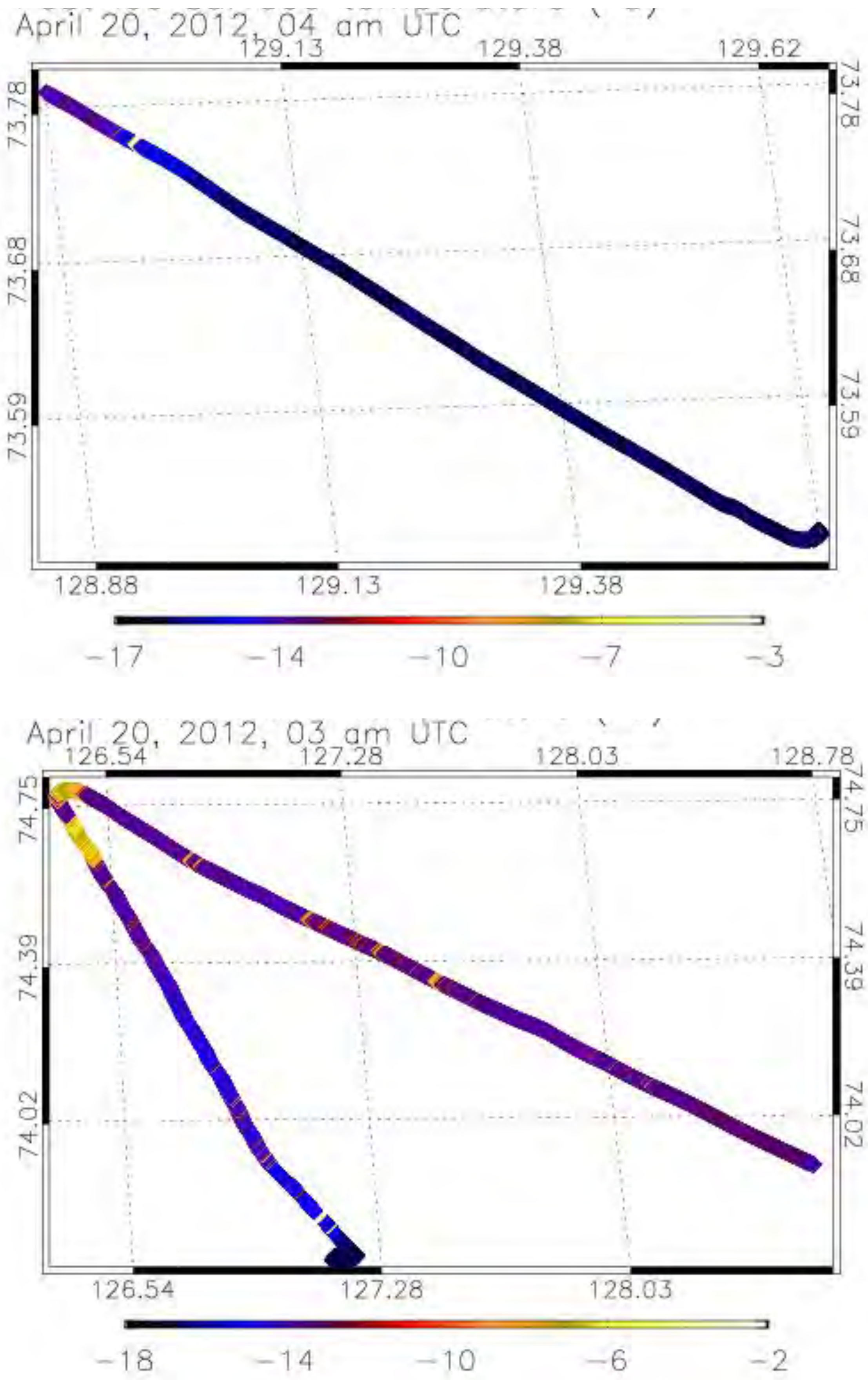


Fig. 13: Ice-surface temperature plotted along the flight track, April 20, 2012.

METEOROLOGICAL INVESTIGATIONS

A. Helbig
Trier University, Trier, Germany

Objectives

The objective of the project is to improve our understanding and quantification of the influence of Laptev Sea polynya processes on the atmosphere/ocean/sea-ice system. Exchange processes, ice formation and polynya dynamics are examined with a combination of atmospheric and sea-ice/ocean models and remote sensing methods. Changes in polynya characteristics are investigated for the past three decades. Polynyas and leads are identified from multi-sensor satellite data and put into context with atmospheric circulation patterns. At the same time, the distribution and abundance of thin ice within these areas is derived by means of satellite remote sensing to determine potential heat loss from the surface to the atmosphere. Detailed model studies subsequently allow simulating and interpreting associated changes in the atmospheric boundary layer.

The outcome of this project is expected to give insight into the role of the Laptev Sea polynyas for the ice production of the Arctic and on boundary layer modification, which is of primary interest for questions of "Arctic amplification" of global climate change.

Methods and equipment

Model studies and remote sensing algorithms both are critically dependent on verification data. This means that sea-ice and atmospheric data have to be collected in the region of interest to allow for verifying algorithms and model performance. During the expedition TRANSDRIFT XX the meteorological regime was studied at the site Camp North (TI12-01) near the fast-ice edge of the West New Siberian (WNS) polynya with high temporal resolution using Automatic Weather Stations (AWS). A second AWS and a Radiation/Turbulence Station (RTS) were set up over the fast ice at the site Camp South (TI12-3) (Fig. 14).

The AWS and RTS data are not submitted to the GTS and, therefore, can be used to validate reanalyses (e.g., NCEP – National Centers for Environmental Prediction, ERA-Interim) and numerical models used in the project. Moreover, these in-situ data provide meteorological information for other subprojects (oceanography, ice physics).

Profile flights by helicopter across the polynya and measurements of the ice surface temperature with a very precise radiation pyrometer KT15 IIP were carried out. KT15 measurements over fast ice and sea ice will yield reference data for the satellite surface temperatures.

Automatic Weather Station (AWS)

The AWS observations comprise measurements of wind, temperature, humidity, barometric pressure, global radiation, net radiation and surface temperature. At both sites identical AWS were deployed.

To ensure that the data loss was minimized, parallel measurements of air temperature and horizontal wind vector with different sensors on the AWS were carried out. The following sensors were used:

- wind speed and wind direction
  Ultrasonic Anemometer (Campbell WindSonic, USA-2D)
  Young Wind Monitor Model 05103

- air temperature and humidity
  Campbell Scientific CS215
  Electric ventilated thermometer (Frankenberger)
- net radiation
  NR_LITE Net Radiometer (Spectral range: 0.2-100 µm)
- global radiation
  SP-110 Silicon-cell photodiode pyranometer
- surface temperature
  IR-Radiometer Apogee S-111, 22°; Wavelength range 8 – 14 µm
- barometric pressure
  Barometric Pressure Sensor RPT410F

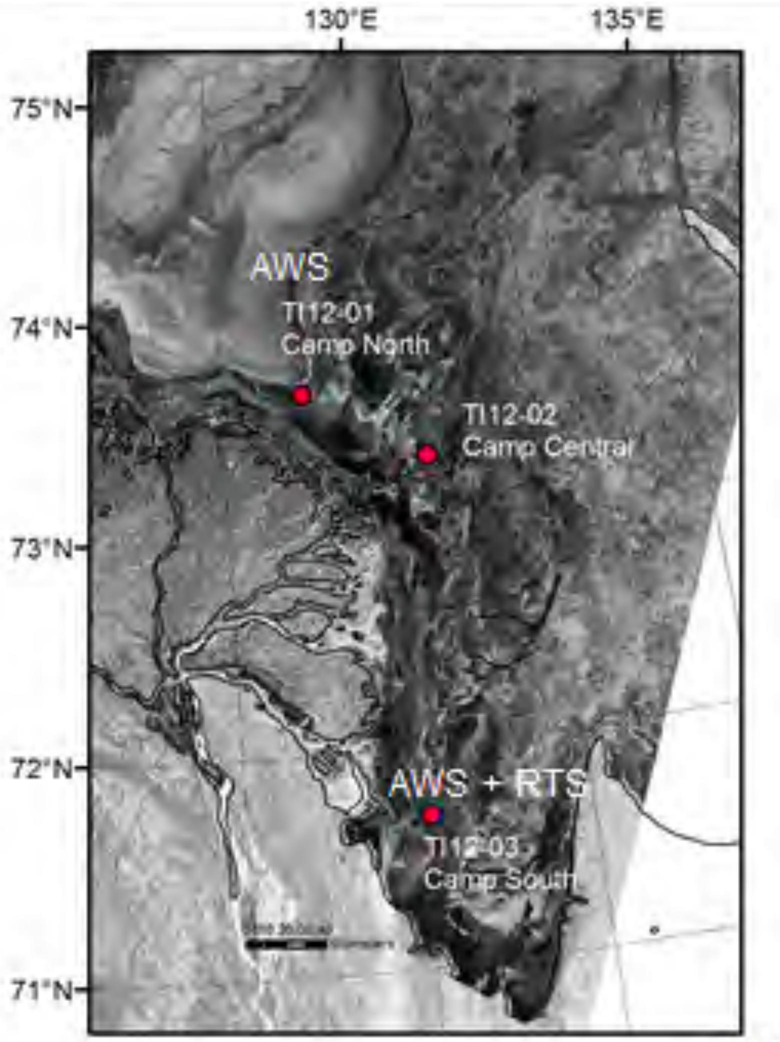


Fig. 14: Ice coverage and position of the West New Sibirian Polynya on March 24, 2012 as well as the positions of AWS at Camp North, Camp Central and AWS and RTS at Camp South.

The tripods of the AWS were positioned directly on the flat and smooth fast ice, and were vertically adjusted and fastened with ice screws. The sensors were mounted at each AWS at the same height above ground (fast ice). The snow cover on the fast ice varied between the two locations. The change of snow depth during the measurement period was negligible.

The sensor heights were as follows:

- air temperature, humidity: 2.0 m above snow
- net radiation:1.5 m above snow
- global radiation: 1.5 m above snow
- wind speed, wind direction Young: 3.0 m above snow
- USA-2D: 2.8 m above snow
- surface temperature: 0.4 m above snow

For data storage a data logger Campbell CR1000 in conjunction with a memory card was used. The stored values are averages over 10 minutes and daily extreme values.

The data are available as 10-min and 1-h averages after post-processing (including calibration and validation).

Radiation/turbulence station (RTS)

The RTS records continuously the components of short-wave (global radiation, reflected radiation) and the incoming and outgoing long-wave radiation fluxes. In addition, snow height and the turbulent fluxes of momentum and sensible heat are measured. The following sensors were used:

- 3D components of wind vector, air temperature

  Ultra Sonic Anemometer METEK USA-1
- solar radiation, reflected solar radiation, atmospheric long-wave radiation, terrestrial long-wave radiation, albedo

  Net Radiometer Campbell CNR4
- snow depth

  Sonic Ranging Campbell SR50 a

The sensor heights were as follows:

- radiation components: 1.5 m above snow;
- wind vector USA-2D: 13.0 m above snow;
- snow depth: 1.3 m above snow.

The power supply was made by photocells in conjunction with a battery.

For data storage a Data Logger Campbell CR3000 in conjunction with a memory card was used. The stored values are averages over 1 second, 1 minute and 10 minutes and daily extreme values.

IR surface temperature

The radiation pyrometer KT15-IIP (manufacturer: HEITRONICS Infrarot Messtechnik GmbH Wiesbaden) is used for measuring the surface temperature of open water, ice and snow (Fig. 15).

The emitted long-wave radiation of the surfaces is detected in the wavelength range of 9.0 to 11.5 µm. Within this wavelength range, the influence of atmospheric gases (especially water vapour and CO_2) is very low, thus the flight altitude is not important for the accuracy of the measurement results. The device provides temperature values considering an arbitrary emission coefficient between ε = 0 and 1. For all measurements we choose an emission coefficient of 1.0. The measurement range of the device spans the range of -50 to 200 °C. The spatial resolution is 4 m at 100 m flight altitude.

The setting time is 1 s. temperature values are transferred via a serial port to the computer. The software EasyMeas was used for data logging and real-time plotting, which guaranteed a continuous control during flight operation.

Fig. 15: IR pyrometers used for surface temperature measurements.

Observations

<u>Observations at Camp North</u>

AWS ID:	BLAU
Start of observations:	26.3.20126:00 UTC
End of observations:	16.4.2012 5:55 UTC
Coordinates:	73° 38.556'N, 128° 43.651'E
Location:	Fast ice, depth 80 cm, snow cover ca. 4 cm, 3.5 km south of polynya ice edge, 100 m southwest of mooring station. Free air flow from all directions (Fig. 16)

Fig. 16: AWS at Camp North.

Observations at Camp South

AWS ID: ROT
Start of observations 4.4.20125:15 UTC
End of observations 19.4.20121:10 UTC
Coordinates: 71° 41.072'N, 130° 09.154'E
Location: Fast ice, depth 160 cm, snow cover ca. 5-10 cm.
Free air flow from all directions (Fig. 4).

RTS
Start of observation 4.4.20125:30 UTC
End of observations 19.4.20121:20 UTC
Coordinates: 71° 41.073'N, 130° 09.227'E
Location: Fast ice, depth 160 cm, snow cover ca. 5-10 cm.
Free air flow from all directions (Fig. 17)

Data losses of the RTS station occurred because of data logger problems.

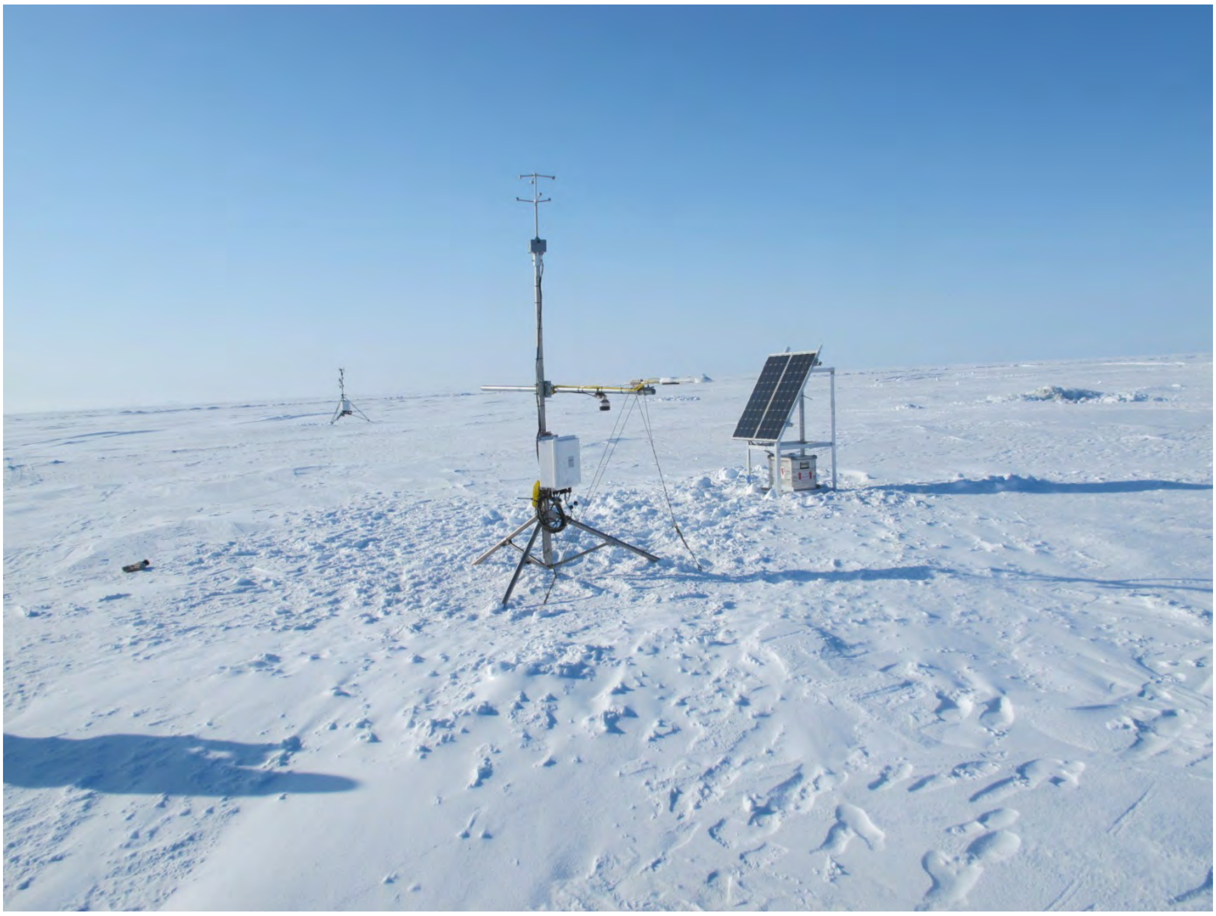


Fig. 17: AWS (left) and RTS at Camp South.

Profile flights over polynya and fast ice

Profile flight on April 12, 2012

Data: Fast ice surface temperature

KT15 II P is fixed at the left helicopter main landing gear.

Flight track: From Camp North to point N 73° 00', E 130° 00', ca. 48 km

Flight altitude: 100 m above ground

Profile flight at April 20, 2012

Data: Ice thickness, photogrammetric sea-ice imagery and sea ice/water surface temperature

KT15 II P is fixed in the helicopter hatch.

Flight track: From the fast ice edge north over thin ice, ca. 150 km

Flight altitude: 100 m above ground

General meteorological information

For daily meteorological information of the expedition members, flight planning and description of the general synoptic situation, the synoptic observations and radiosonde data from the station of Tiksi (WMO code 21824), analyses and forecasts of different weather services were used from the following sources:

- http://www.wetteronline.de/RussischeFoeder/Tiksi.htm
- Russia's Weather Forecast - Cities (http://meteo.infospace.ru/cities/html/index.ssi)
- Weather Forecast Tiksi, Russia | Tiksi Weather | Wunderground (http://english.wunderground.com/cgi-bin/findweather/getForecast?query=zmw:00000.1.21824?
- http://www.wetterzentrale.de/topkarten/fsavnnh.html
- http://weather.uwyo.edu/models/fcst/index.html?MODEL=gfs004&REGION=ANT
- http://wmc.meteoinfo.ru/forecasts5000/russia/republic-saha-yakutia/tiksi
- http://weather.uwyo.edu/upperair/sounding.html
- http://meteo.infospace.ru # Weather archive data # Weather station # WMO index: 21824
- Global Surface Summary of Day Data (http://www7.ncdc.noaa.gov/CDO/cdoselect.cmd?datasetabbv=GSOD&countryabbv=&georegionabb)
- Integrated Global Radiosonde Archive (ftp://ftp.ncdc.noaa.gov/pub/data/igra/)

The GFS analyses N-Hemisphere (Geopot. 500 hPa + SLP) on 00 UTC and the radiosonde ascent data on 00 and 12 UTC at Tiksi for the period March 20-April 21, 2012 are archived.

OCEANOGRAPHIC ACTIVITIES

S. Kirillov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Objectives

The Siberian Arctic shelves are the regions where the most pronounced consequences of climatic changes have recently been observed. These changes are evident in all environmental processes occurring in the ocean, atmosphere and sea ice. The warmer atmosphere and longer ice-free period result in more heat being accumulated in the surface, intermediate and bottom water layers during summer. This heat is a source for delayed freeze-up and the thinning of the ice thickness in the following winter. The Laptev Sea thermal conditions are also affected by warmer Atlantic Waters (AW) penetrating the outer and mid-shelves through the submarine canyons.

The heat accumulated from the atmosphere during summer and AW affects the sea-ice formation in the Laptev Sea by increasing the heat flux from the bottom layer toward the surface. The baroclinic tidal water dynamics in the polynya is suggested to be one possible mechanism that leads to shear-driven turbulence and vertical mixing that result in an upward heat transport. However, it is not yet clear how the current shear affects the vertical exchange during winter.

From November until July nearly the whole inner shelf of the Laptev Sea is covered by fast ice. Only recently regional coupled sea-ice/ocean models, like NAOSIM (North Atlantic – Arctic Ocean – Sea-Ice Model), have started to include this important feature. First results of model runs with and without fast ice have shown that the immobile ice cover in the Laptev Sea has a pronounced effect on the regional ocean circulation and, therefore, also on the transport of energy and matter. To estimate model sensitivities and to improve the models themselves, it is necessary to carry out short-term observations (approx. 30 days) of the current regime under the fast ice. Thus, the continuation of field activities within the framework of the joint Russian-German project "The Eurasian Shelf Seas in the Arctic's Changing Environment: Frontal Zones and Polynya Systems in the Laptev Sea" provides the possibility to carry out scientific researches aimed at the following objectives:

- to determine the general pattern of temperature and salinity over the Laptev Sea shelf and figure out the position of frontal zones formed between the fresh river water plume and the more saline waters of the deep Arctic Basin;
- to obtain oceanographic time series in order to determine the key mechanisms that result in seasonal and climatic variations of the water mass properties and the current regime in the frontal zones and under the fast ice;
- to characterize the tidal dynamics and their influence on shear-driven turbulence in the water column.

Methods and equipment

Two major oceanographic activities were accomplished within the framework of the TRANSDRIFT XX expedition: the episodically repeated CTD (conductivity/temperature/ depth) measurements from the fast ice in close vicinity of the West New Siberian and Anabar-Lena polynyas and deployment of short-term mooring stations equipped with current meters and CTD devices.

All oceanographic activities during TRANSDRIFT XX were aimed to collect hydrographic data within the research polygon. The holes in the ice were drilled by motor drill. In order to reduce the error of measurements, caused by ice crushing during drilling, and sensor cooling under low air temperatures, the CTD probe was kept for some time under ice, and the measurements were taken repeatedly.

The CTD measurements were carried out using a pumped SEACAT Profiler SBE19plus equipped with external sensors for oxygen (SBE 43), turbidity (Seapoint OBS) and fluorescence (Wetlab Wetstar). The CTD gathers data on conductivity, temperature, dissolved oxygen, turbidity and chlorophyll at ~10-15 cm vertical intervals. The accuracies of temperature and recalculated salinity were ±0.002˚C and ±0.001 psu, respectively.

The mooring stations, deployed during TRANSDRIFT XX, consist of three types of oceanographic instruments:

- Teledyne-RDI Acoustic Doppler Current Profiler (ADCP) Workhorse Sentinel 300 kHz and 600 kHz: accuracy of current velocity measures is ±0.5% of velocity and ±0.5 cm/s; standard compass accuracy is ±2°;
- Conductivity-Temperature-Turbidity unit XR-420 by RBR: accuracy of temperature is ±0.002°C; accuracy of conductivity is ±0.003 mS/cm;
- Conductivity-Temperature-Depth 37 SMP by Seabird Electronics: accuracy of temperature is ±0.0002°C; accuracy of conductivity is ±0.003 mS/cm; accuracy of pressure is ±0.1% of full scale range.

The design of the moorings was traditional for ice-covered regions. The anchor and the rope with the attached instruments were slipped down a specially drill ice hole of a big diameter. The upper end of the rope was fixed on the ice surface.

All the sensors listed above were preliminarily calibrated and recalibrated after the expedition.

Works accomplished

All together seven oceanographic stations were carried out from March 26 to April 19. These stations were repeated at three positions (Camp North, Central and South, see Table 6).

Table 6: Positions of oceanographic stations carried out during TRANSDRIFT XX

Station	Camp	Date	Longitude	Latitude	Depth, m
TI12-01	North	26.03.12	128.678°E	73.657°N	17.5
TI12-02	Central	27.03.12	130.670°E	73.358°N	24.0
TI12-05	South	04.04.12	130.152°E	71.693°N	10.5
TI12-06	North	10.04.12	128.678°E	73.657°N	17.5
TI12-07	Central	12.04.12	130.670°E	73.358°N	24.0
TI12-09	North	17.04.12	128.678°E	73.657°N	17.5
TI12-10	South	19.04.12	130.152°E	71.693°N	10.5

Two autonomous oceanographic moorings beneath the ice were deployed during TRANSDRIFT XX. One of them (mooring North) was deployed on March 26, 2012 at the position 73°38'34.6"N 128°43'40.0"E and recovered on April 17, 2012 in close vicinity of the polynya to reveal the response of the water-column structure and dynamics to the processes in the ice-free area. The key specification of this mooring was to obtain quantitative information about the vertical mixing within the pycnocline layer. In order to get this information, the mooring was equipped with a Workhorse Sentinel ADCP (Accoustic Doppler Current Profiler) 300 kHz, two RBR and four Seabird CTDs as presented in Figure 18. The segment of the mooring line (8.0-12.5 m) with several CTDs coincides with the position of the seasonal halocline at Ti12-01 (Fig. 19, left panel). All instruments worked successfully during the deployment period, providing three-weeks of records. The sampling interval for the CTD devices was programmed as 1 minute except for the lower RBR instrument with a 2-minutes sampling interval. The ADCP measured the current profile every 30 sec with an 0.5 m vertical bin interval and recorded time-averaged profile parameters every 15 minutes. The depth range of the current-velocity measurements varied from about 4.5 m and to the deepest reliable measurements at 14 m.

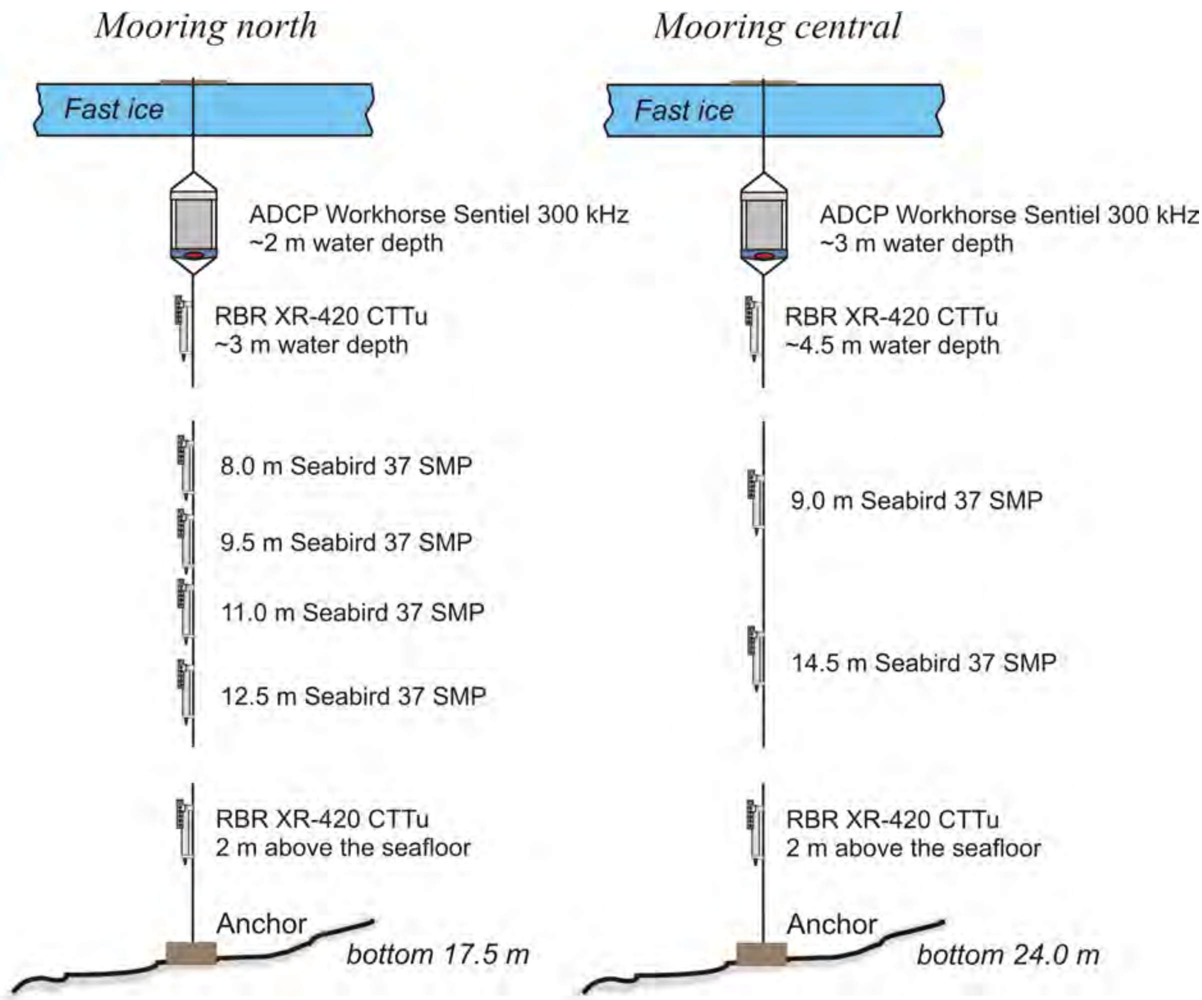


Fig. 18: Scheme of short-term moorings deployed under the fast ice at 73°38'34.6"N 128°43'40.0"E (Camp North) and 73°20'2.9"N, 130°40'13.8"E (Camp Central).

The mooring at Camp Central was deployed on March 27, 2012 at the geographical position 73°20'29.9"N, 130°40'13.8"E and recovered two weeks later on April 12, 2012. The mooring was equipped with a Workhorse Sentinel ADCP 600 kHz, two RBR and two Seabird CTDs (Fig. 1). The time interval of all records was similar to those of mooring North (1 min for CTDs and 15 min for ADCP). The current velocities were measured every 0.5 m within the depth interval from 4 m to 14.5-15.0 m. The full length of all parameters was gathered except for the conductivities measured by two Seabird 37SPM CTDs. The most plausible reason of failure is that the conductivity cell filled with slush-ice. Therefore, the conductivity data from these two sensors are assumed to be incorrect.

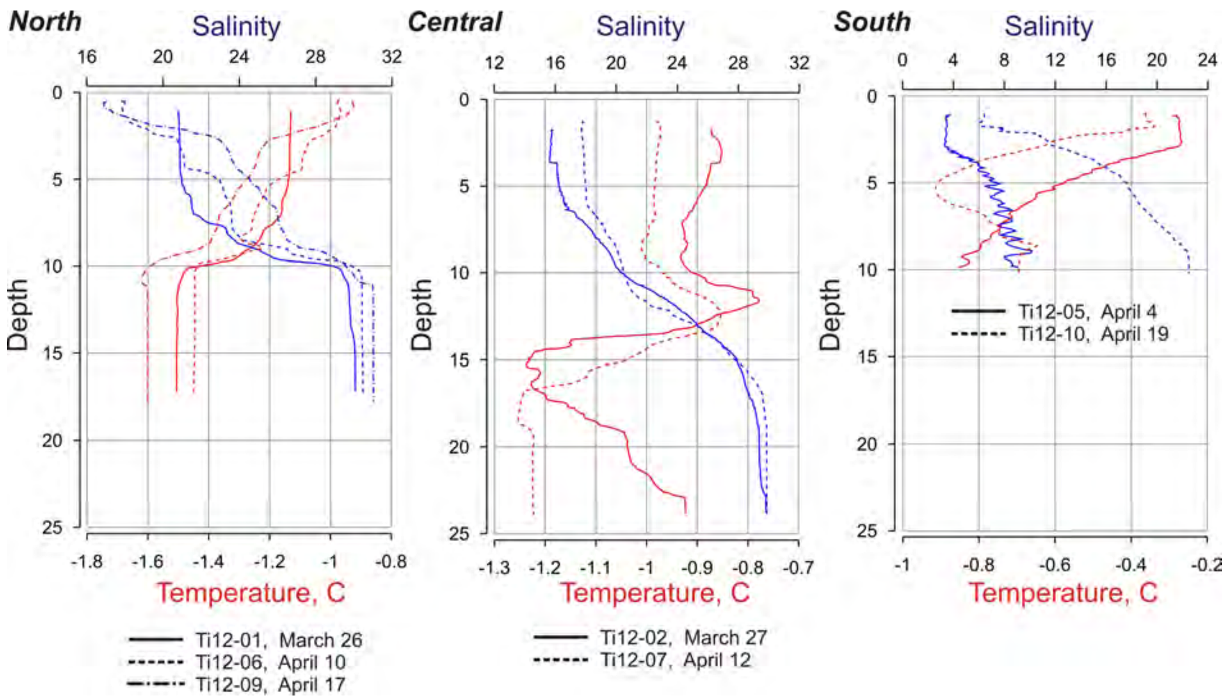


Fig. 19: Vertical temperature and salinity profiles measured during TRANSDRIFT XX.

Preliminary results

The vertical termohaline structure in the research area, observed during TRANSDRIFT XX, is conventional for this period of the year. Surface salinity varies from 6 psu east of the Lena Delta to 16-21 psu at the position of camps North and Central (Fig. 2). Water temperature at the surface is closely related to salinity and coincides with the freezing temperature of seawater at the given salinity.

The seasonal pycnocline beneath the surface layer occupies the depth range from 6-7 m to 10-15 m (Fig. 2) insulating surface waters from the (usually) well-mixed bottom layer with salinities of about 29-31 psu. The temperature of the bottom layer does not necessary equal the freezing point (FP). For instance, bottom temperature is ~0.2-0.3°C above the FP at station Ti12-02 or Ti12-10 (Fig. 19), thus giving evidence of overwintered heat accumulated in the water column during the previous summer.

The time-series of temperatures (T), salinities (S) and current velocities (U), recorded at the mooring stations, present the second portion of oceanographic information which is essential to analyze the influence of wind forcing on polynya activity, water dynamics and, therefore, physical mechanisms responsible for the changes of regional and local thermohaline structures. At the moment the records from the mooring are analyzed. the 22-day-long records of TS North are presented in Figure 3 as colored lines indicating different depth levels. The pronounced TS variability in the surface and pycnocline layer is evident here and can be further related to wind forcing and/or water dynamics. Careful attention has to be paid to the changes of temperature and salinity in the pycnocline as dramatic "jumps" had periodically (also as a part of the tidal cycle) occurred. Another feature of these records is the alternating character of thermal stratification in the bottom layer. Temperatures measured at 15.5 m showed higher values than at 12.5 m in some periods. The longest period was during the first half of the records (Julian days 89-96, see Fig. 20).

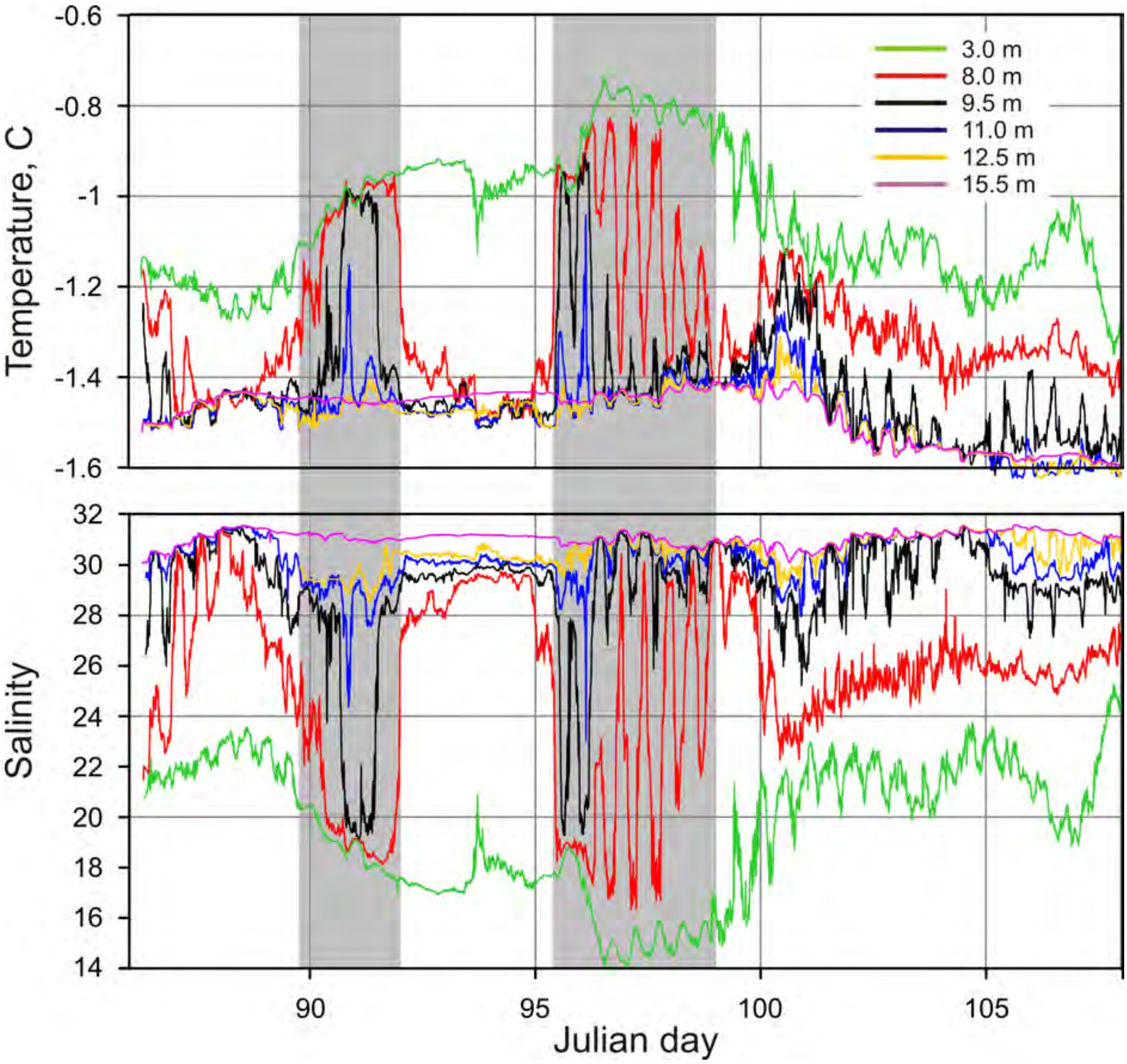


Fig. 20: The temperatures and salinities measured at different depths at Camp North.

Figure 21 helps to interpret some of these changes in terms of water dynamics. The rapid salinity decreases in the middle part of water column (within the density interface) result from the transition of fresher surface waters toward the northwest. The amplitudes of the observed salinity changes are abnormally high and, therefore, cannot be explained by horizontal salinity gradients. Most likely they are related to the larger thickness of the surface mixed layer beneath the fast ice relatively to the polynya region. In general, the time series of salinity, presented in Figure 22, prove that the CTD sensors, deployed in the pycnocline layer, periodically get into the surface/bottom mixed layers.

In contrast, the observed relatively high temperatures near the bottom fairly coincide with episodes of water inflow from the northwest, which might be a result of heat advection in the bottom layer from deeper regions. The source of this heat has been discussed in different papers and is assumed to be derive from (1) modified Atlantic Waters penetrating into the mid-shelf of the Laptev Sea through the deep paleovalleys and (2) overwintered waters heated by solar radiation which accumulated in the bottom layer after fall storms in the area of research.

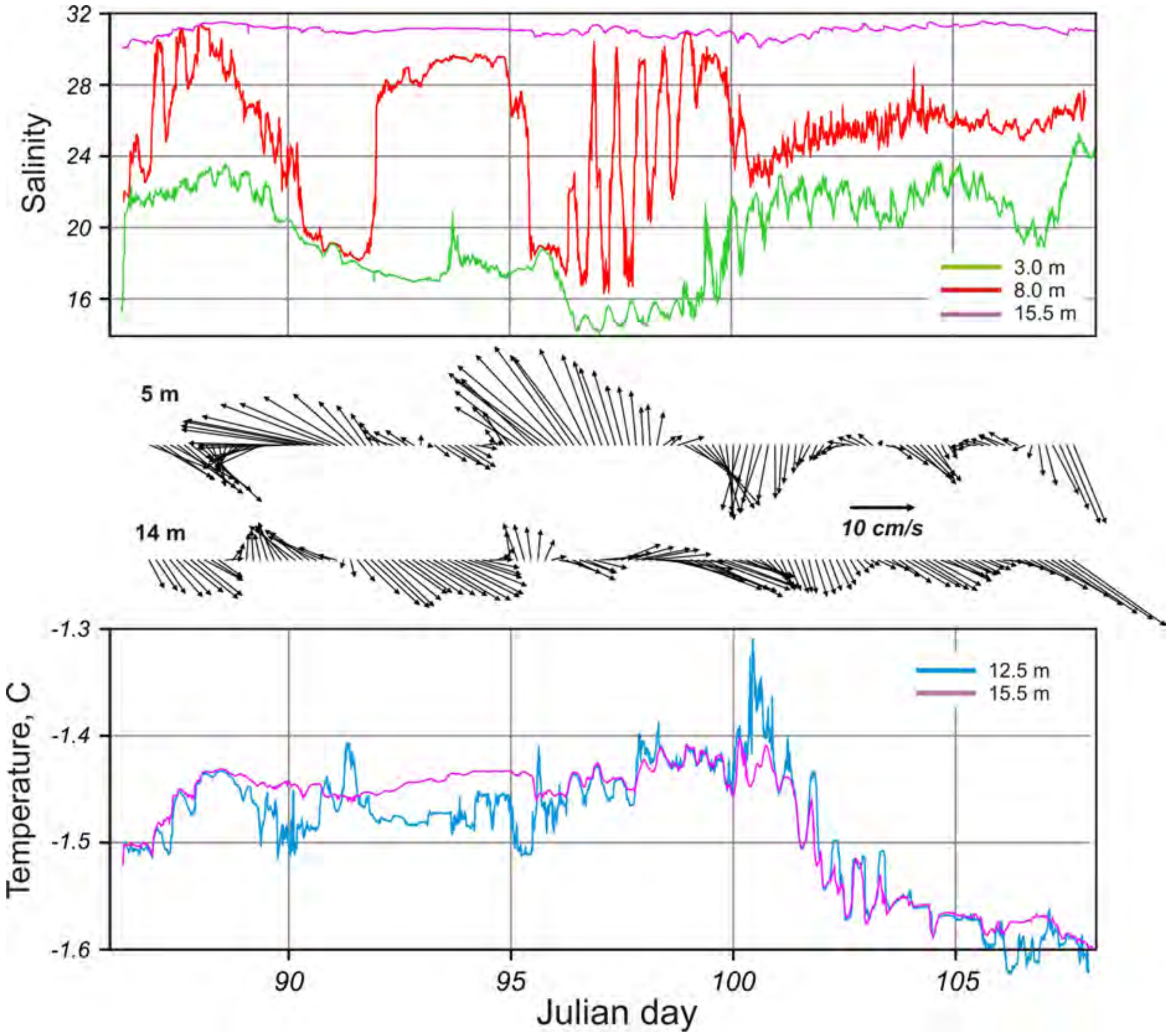


Fig. 21: The linkage between the thermohaline changes and daily averaged water dynamics in the surface (5 m) and bottom (14 m) layers at Camp North.

Another part of our preliminary results concerns the tidal dynamics observed at Camp North and mostly related to the lunar (M_2) and solar (S_2) semidiurnal constituents of tidal motions (Fig. 22). Tidal decomposition reveals strong tidal currents amplified within the density interface and reduced beneath the sea-ice and in the bottom layer by frictional forces. The maximum amplitudes of M_2 and S_2 currents are 26 and 14 cm/s. These maxima are observed at ~7-8 m water depth and roughly oriented across the bottom topography from NW to SE (Fig. 22). Another remarkable feature, linked to the tidal motions, is that the mooring line is lifted or lowered with the tidal frequency (see Fig. 22a). The vertical movement of the CTDs is more intensive during the maximum of the neap-spring tide. Considering the mooring design, we assume two reasons of such behavior. According to this assumption the deviation of the mooring line from the vertical position might be caused by (1) frictional drag of water and (2) minor horizontal movement of the fast-ice bottom.

All results mentioned above are preliminary and original data have to be analyzed more scrupulously in order to figure out the physical key mechanisms contributing to the current state and evolution of water properties within the polynya area.

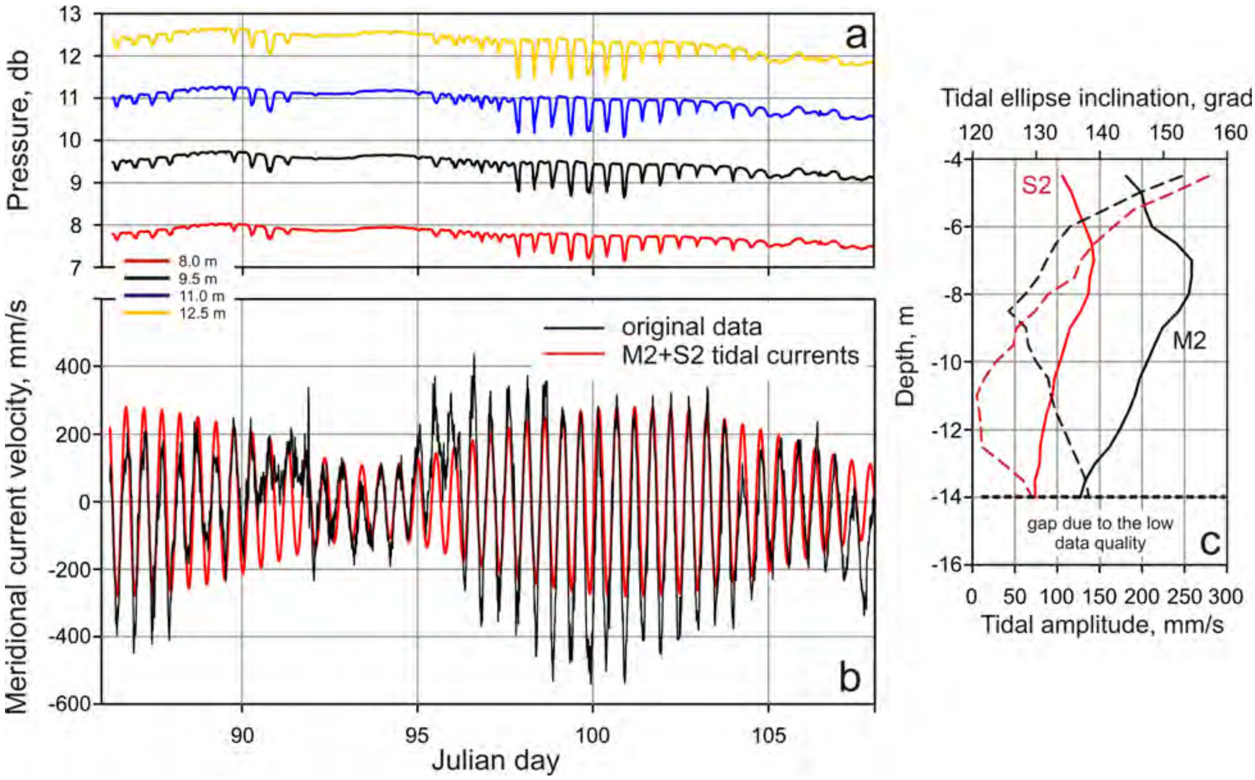


Fig. 22: Temporal evolution of CTD depths (a), current velocities at 7 m depth (b) at Camp North (red line in the lower panel indicates the tidal currents defined by tidal decomposition analysis), and the lunar and solar semidiurnal (M_2 and S_2 respectively) tidal ellipse parameters (c). The solid lines in (c) depict the amplitude of the tidal current (half of major axis of tidal ellipse) and the dashed lines show the tidal ellipse orientation.

HYDROCHEMICAL STUDIES

A. Novikhin
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Hydrochemical studies are an important part of the environmental monitoring. The dissolved oxygen (DO) is necessary for the respiration of organisms. The DO is contributed to the seawater from the atmosphere and during photosynthesis. It is required for respiration and organic matter decomposition. Nutrients (silicates, phosphates, nitrites, nitrates and ammonia) are the mineral basis for primary production.

To understand the hydrochemical processes in the polynya area and to reveal the scale of the influence of global change on the Laptev Sea polynya area, the hydrochemical studies with the in framework of the expedition TRANSDRIFT XX (Fig. 23) were focused on the following tasks:

- to study temporal and spatial changes in the hydrochemical parameters in the river plume area;
- to study the water-column structure in the Laptev Sea polynya region;
- to reveal the scale of the influence of global change on the hydrochemical structure, and on the hydrochemical and hydrobiological processes in the polynya region;
- to investigate the seasonal and interannual changes in the hydrochemical parameters.

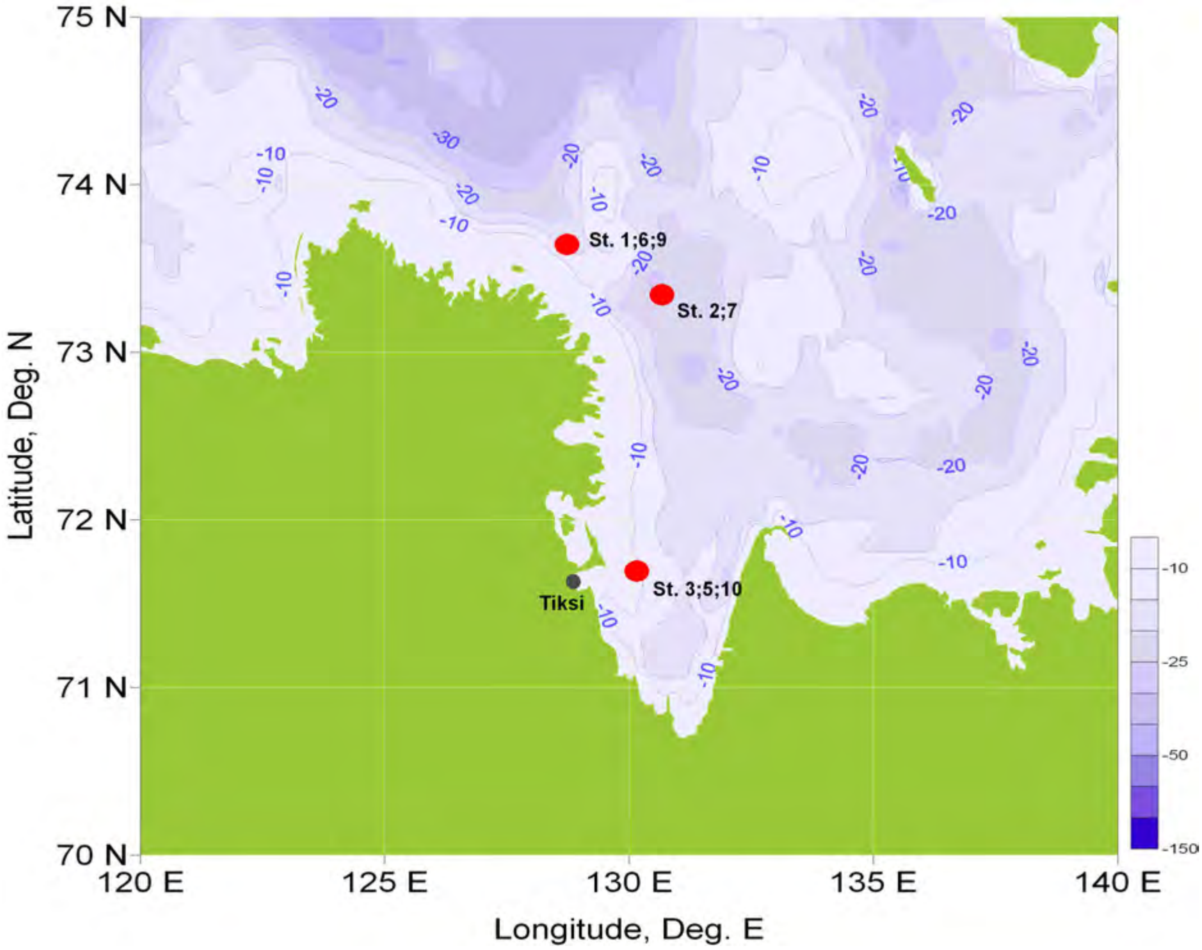


Fig. 23: Station map of the expedition TRANSDRIFT XX to the Laptev Sea.

Methods

Water sampling was carried out with plastic 2-liter bottles. The DO samples were taken first in oxygen glass bottles of 100 ml volume. Just after sampling the DO was fixed with 1 ml of manganese chloride and 1 ml of potassium iodine and sodium hydroxide solution. The sample was mixed. In this state, the samples were transported to the laboratory. After precipitation, the samples were dissolved with 2 ml of sulfuric acid. The content of DO was measured with sample titration with sodium tiosulphate using an automatic burette. All procedures were performed according to the modified Winkler's method.

Nutrients were sampled in 125 ml and 50 ml plastic bottles. As soon as the air temperature during field work was lower than -21°C, the 50 ml bottles were immediately frozen in a dark place outside the tent. Both kinds of samples were transported to the laboratory. The 125 ml samples were added to Nessler cylinders with 35 ml for silicates and with 50 ml for phosphates analysis. To the phosphates samples, 4 ml of a mixed reagent and 1 ml of ascorbic acid were added sequentially to obtain the color. After 10 minutes' exposing, the samples were analyzed with a photo-colorimeter FC-3. To the silicate samples, 1 ml of a mixed reagent was added first. After 10 minutes' exposing, 1 ml of oxalic and 1 ml of ascorbic acid were added sequentially to the sample to obtain the color. Then the samples were analyzed – after 30 minutes' exposition – with a photo-colorimeter FC-3. Then the frozen samples were transported to the German-Russian Otto Schmidt Laboratory of Polar and Marine research for analysis. To determine the nutrient concentrations, an autoanalyzer SKALAR Sun Plus System will be used. The mechanism is based on the so-called Segmented Continuous Flow principle. The core of this method consists in dividing the water sample into micro samples using air bubbles. Before putting the micro sample into the optical cell, the required chemicals are added to it to color it. Nutrient concentrations are measured with the photocolorimetric method.

The ice cores were transported to the laboratory and then cut into 10-cm layers and melted in the plastic containers in the dark. Then, if necessary, they were filtered and analyzed as nutrient samples.

Preliminary results

During the expedition, 8 oceanographical stations were occupied. The general station map is presented in Figure 23. At 7 stations the water sampling for DO, silicates and phosphates was carried out with 2-l-Niskin bottles. Simultaneously the water column was tested with DO, fluorescence and turbidity sensors mounted on a CTD sensor SBE 19plus.

In total, 28 water samples were taken for nutrients (phosphates, silicates) and DO. Six ice cores were processed (78 samples).

Figure 24 shows the nutrient and DO distribution in the water column. The DO concentrations were in the range of 5.32 ml/l (station 2, bottom layer) to 9.64 ml/l (station 5, 2 m). The average DO concentration was estimated as 7.57 ml/l. The silicate concentrations range from 24.83 µM/l (station 6, 10 m) to 107.26 µM/l (station 5, 3m). The range of phosphates is 0.87 µM/l (station 10, 2 m) to 4.7 µM/l (station 6, bottom layer).

The water was sampled at 3 geographical points named Camp North, Camp Central, and Camp South. The sampling was carried out during the first and the second half of the expedition. That allows investigating the nutrient and DO dynamics during one month.

The DO concentrations decreased with the depth to the minimum of 5.32 ml/l in the bottom layer at Camp Central. There is a bottom depression in this region. Probably in this area during the Lena River flood period, the low-DO water mass is formed. For the expedition time the DO concentrations were increased at Camps North and Camp South. At Camp Central, the DO values did not change significantly.

The highest silicate concentration was observed in the surface layer of Camp South (about 110 µM/l). Northward the concentrations decrease to 40 µM/l at Camp North The concentrations decrease with depth approximately to 35 µM/l at all stations. During the expedition the silicate amount increased significantly in the upper 5 m layer at Camp South. At Camp North an increase in silicates was observed approximately to 15 m depth. At Camp South, silicates in the upper 10 m layer decreased to 10 µM/l.

Phosphates increase with depth. The minimum values were observed at Camp South. At all points phosphates decreased during the expedition. This fact coincides with the beginning of the photosynthetic activity.

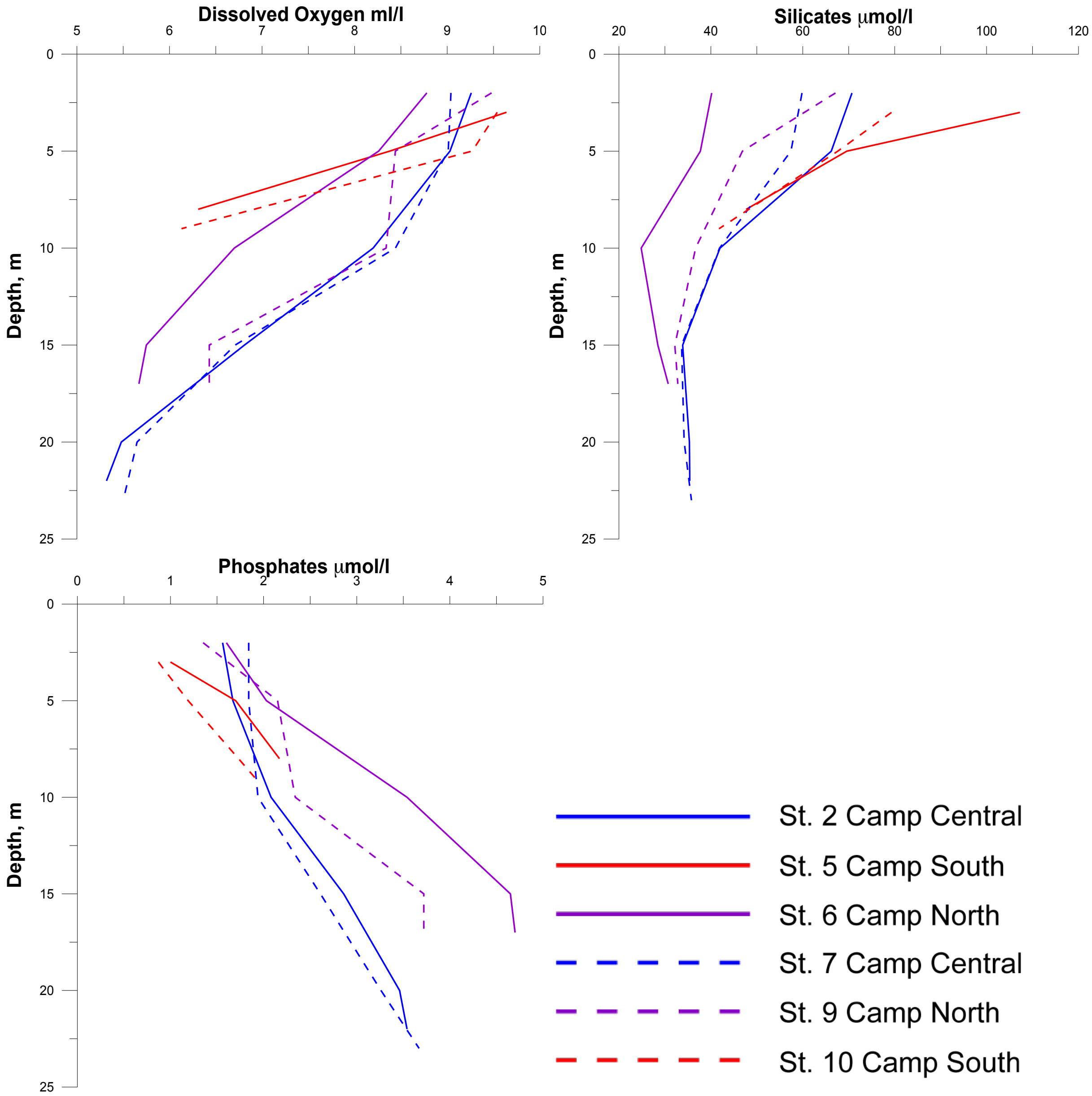


Fig. 24: The vertical distribution of DO, silicates and phosphates in the water column during the TRANSDRIFT XX expedition.

In the treated ice cores (Fig. 25) silicates were in the range of 4.73 µM/l (station 5, 70-80 cm) to 18.9 µM/l (station 10, 140-150 cm). Phosphates were observed in the range between "analytical zero" (stations 2 and 5) to 4.44 (station 6, bottom of the core).

Silicate concentrations decrease from the upper core part to 70-90 cm (3-6 µM/l). Then they increase to 18-20 µM/l (130-150 cm) at Camp Central and Camp South. Further down to the bottom part of the ice core, the concentrations increase.

The phosphate distribution pattern in the ice cores is rather complicated. There are a lot of local extremes and concentrations are estimated to range between 0 and 1.2 µM/l. For all cores, there is a maximum of phosphates in the lower part. This phenomenon is probably connected with phytoplankton activity. In the bottom part of the ice cores taken during the second half of the expedition, there is an evident layer of green algae. This was especially pronounced at Camp North, which is located close to the polynya with ice thicknesses of only 80-90 cm.

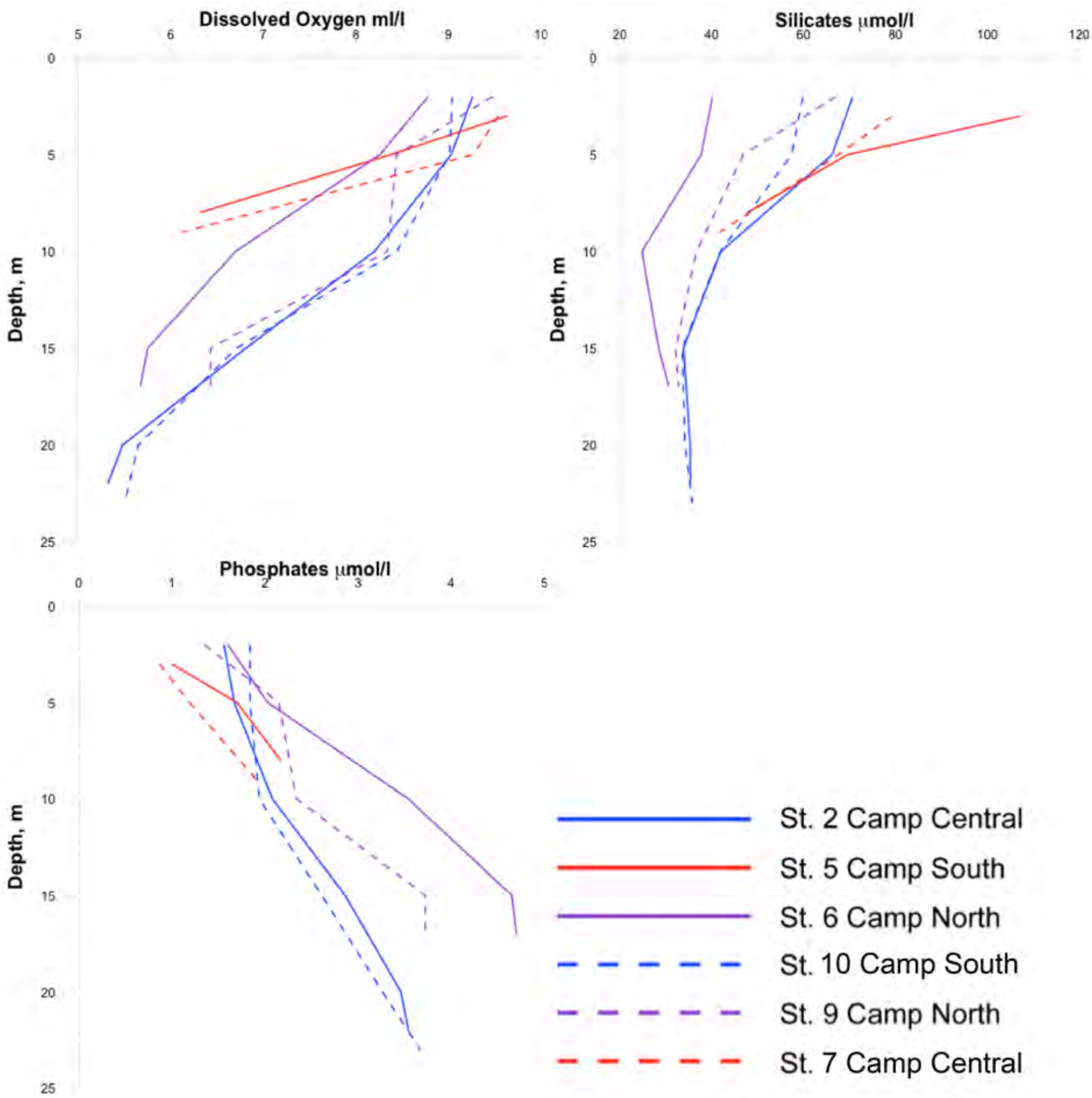


Fig. 25: The vertical distribution of silicates and phosphates in the ice cores during the TRANSDRIFT XX expedition.

Silicates concentration in the water just under the ice cover is obviously higher than in the ice. Phosphates concentrations in the water under the ice cover are slightly higher than in the ice.

Conclusions

According to the obtained data, the nutrient and DO distribution and values in the water column are usual for the study region in winter. The combined analysis of the hydrochemical parameters and time variations together with the biological data and the polynya location allows supposing that during the expedition, we observed the very beginning of the spring algae bloom and the shift from winter to summer hydrochemical and hydrobiological regimes. This was also proved by the nutrient measurements in the ice cores and by biological data.

DISSOLVED ORGANIC MATTER (CDOM AND DOC) IN LANDFAST ICE AND UNDERLYING WATER COLUMN

J. Hölemann
Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Introduction

Colored dissolved organic matter (CDOM), also known as gelbstoff, is the component of total dissolved organic matter (DOC) that absorbs light over a broad range of visible and UV wavelengths. The chemical composition, origin, and dynamics of CDOM in aquatic systems are still poorly understood.

Estimates of the contribution of CDOM to total dissolved organic carbon in the ocean range from 20% to 70%, with highest values in coastal regions. CDOM has proven to be a useful tracer not only for carbon but also as a proxy for mixing in a wide variety of environments. CDOM has also been used to trace input from rivers and to distinguish between source waters of different origin. CDOM, therefore, also provides a means of studying ocean surface circulation features.

Terrestrial CDOM dominates the western Arctic Ocean, which receives 10% of the global river discharge. First results of CDOM measurements in the Laptev Sea from the TRANSDRIFT XVII summer expedition indicate that two different source waters, which are characterized by different salinity/CDOM relations, exist. To study the origin of these water masses, it is necessary to obtain more detailed information about the CDOM concentrations and DOC/CDOM relations in the water column and the sea ice during winter.

Sampling of sea ice and under-ice water

The fieldwork was carried out on landfast ice in Bhuor-Khaya Bay near the major outlets of the River Lena. Sea-ice samples were collected at stations 2, 5, 6, 7, 9, and 10 using an ice corer with an inner diameter of 9 cm. The ice cores were thereafter placed in polyethylene bags and transported to the onshore laboratory in Tiksi. Within several hours after coring the ice core was split into 10 cm long segments, placed in polyethylene boxes to melt in the dark at room temperature. Immediately after melting the water was subjected to vacuum filtration (with a 250 ml NALGENE filtration set at approx. 400 mbar) through a Whatman GF/F glass microfiber filter (4.7 cm diameter) with a nominal pore size of approx. 0.7 µm. The filter was pre-washed with ~20 ml Milli-Q water and approx. 20 ml of the seawater sample. After washing the filter, 250 ml of seawater was filtered. 50 ml of the filtrate was used to rinse the storage bottles. The rest of the filtrate (200 ml) was filled into two storage bottles (high density polyethylene) and stored in a dark and cold environment. CDOM was measured immediately after the expedition at the Russian-German Otto Schmidt Laboratoryfor Polar and Marine Research (OSL) in St. Petersburg using a Specord200 (Jena Analytik). Optical Density (OD) spectra of the filtrates were measured from 300 nm to 750 nm in 1 nm steps using a 10 cm cuvette. Absorption per m was calculated using $2.303 \times OD/0.1$. To determine the total dissolved organic carbon (DOC) concentration, samples will be analyzed at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven.

Under-ice water samples were collected through an ice hole using a 2 l plastic water sampler (Niskin type) at stations 2, 5, 6, 7, 9, and 10 in different water depths. The seawater samples were stored in high-density polyethylene bottles and immediately filtered in the onshore laboratory. Filtration, storage and CDOM analysis was in accordance with the method used for the ice cores. In addition to the water samples a CDOM sensor (Wetlabs) was used to measure the *in-situ* fluorescence of the dissolved organic matter. The pumped sensor was mounted on a Seabird 19 CTD, which also recorded the depth, salinity and temperature.

Results

A detailed description of the physical and chemical structure of the water column under the fast ice is given in the chapters "Hydrochemical studies" and "Oceanographic activities". The ice in Buor-Khaya Bay was mobile until January 2012. During a period with strong winds from the west, a coastal polynya formed at the eastern coast of the Lena Delta in January 2012. Based on the interpretation of ENVISAT radar images, it was possible to track the drift of the newly formed ice from the coast (water depth less than 5 m) to the central part of the Bhuor-Khaya Bay (water depth >20 m) where it became immobile and formed part of the landfast ice of the eastern Laptev Sea. This ice was sampled at station 7 (Fig. 26).

Fig. 26: Ice coore at station 7. All ice cores at this station showed layers with sediment inclusions in the upper 70 cm (i.e., the oldest ice) of the core. Sediment concentrations reached up to 140 mg sediment per kg ice.

The upper 40 to 70 cm of the ice core, which were presumably formed in a coastal polynya, showed high concentrations of sediment (up to 140 mg sediment/kg ice), increased concentrations of dissolved inorganic nutrients (Fig. 27) and a high absorption (measured at 375 nm). Although the initial concentrations of CDOM and inorganic nutrients in the water column are not known, the results indicate that dissolved nutrients and CDOM, like the sea salt, are not completely removed from the ice during the freezing process. Nevertheless, seawater in the near-delta mixing zone (salinity ~5) usually shows CDOM absorptions that are a magnitude of order higher than the values that were measured in dirty sea ice of the same salinity (~7 vs. ~0.5 at 375 nm).

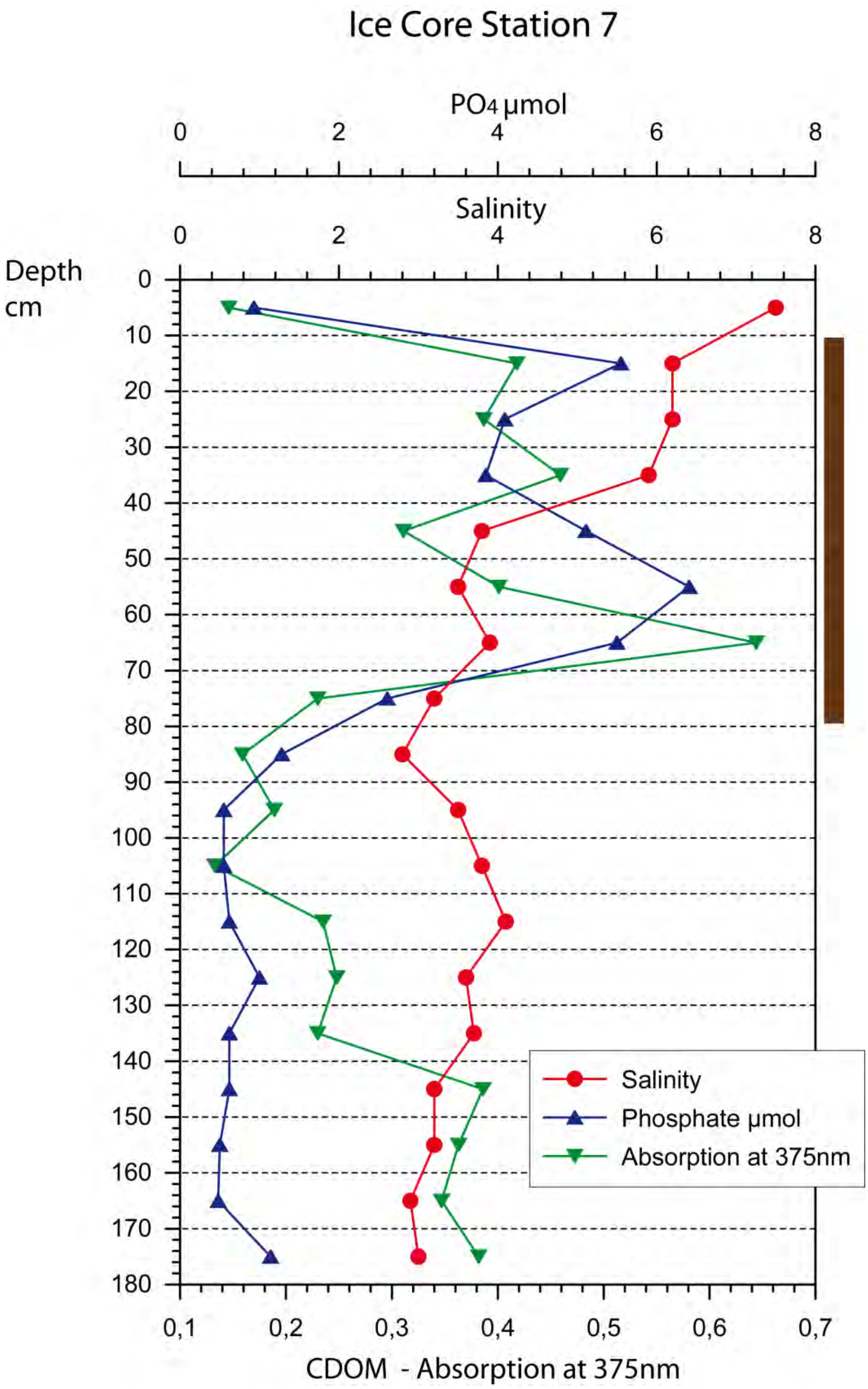


Fig. 27: Chemical profile of a 1.8 m long ice core from station 7.

The CDOM absorption in the under-ice water at 2 and 5 m water depth was 3.4 (at 375 nm) at a salinity of ~18. This salinity/CDOM relation corresponds to the values that were measured in the same region during summer. This indicates that the seasonal variability in CDOM concentration in the River Lena is low. Because sea ice has a salinity/CDOM relation that is one order of magnitude lower than river water, also water masses with a significant contribution of sea-ice melt water should be distinguishable by their low CDOM/salinity ratio from water masses in the mixing zone of the River Lena, which should have a significantly higher CDOM/salinity ratio.

BIOLOGICAL INVESTIGATIONS

E. Abramova[1], I. Kryukova[2,3], F. Martynov[4], A. Novikhin[5], A. Gukov[1], J. Hoelemann[6]

[1]Lena Delta Nature Reserve, Tiksi, Sakha Republic, Russia
[2]Moscow State University, Moscow, Russia
[3]Institute of Water Problems, RAS, Moscow, Russia
[4]St. Petersburg State University, St. Petersburg, Russia
[5]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[6]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Introduction

Investigations of zooplankton on the Laptev Sea shelf most often focus on Copepoda as a main component of marine ecosystems in Arctic regions. Zooplankton communities are often numerically dominated by a few small key copepods, which play a major role in channelling energy through the food webs (Kosobokova et al., 1998; Lischka et.al., 2001; Abramova & Tushling, 2005). It is known that secondary production and standing stock of the micro- and mesozooplankton may be greater than earlier estimates because small species may remain metabolically active, or at least reproducing throughout the year. Especially they may be more important to cycles of organic material in the upper Arctic Ocean during the winter months when the larger copepod species enter a period of metabolic quiescence (diapause) (Conover & Huntley, 1991; Ashjian et al., 2003). While the small copepods contributed less than 5% of the biomass, estimates of their potential growth rates suggest they might contribute upwards of 25% of the metazoan zooplankton production. The true rates of growth and development of these copepods in the Arctic need to be determined to conclusively ascertain their importance (Hopcroft et al., 2005). How Arctic zooplankton survives the dark period when primary production should be totally limited is poorly understood, in part because year-round investigations of the pelagic community at high latitudes, where ice is a major environmental influence, are rare.

The major objectives of our investigations during the TRANSDRIFT XX expedition were:

- to analyze and assess the winter/spring transition and seasonal variations in chlorophyll *a* concentrations in the water and in the sea ice;
- to study winter zooplankton species composition, population structures, abundance distribution in relation to hydrography, hydrochemical and feeding conditions in the eastern area of the Laptev Sea shelf in March-April 2012. Several small brackish-water target copepods (*Drepanopus bungei*, *Acartia longiremis*, *Pseudocalanus* sp. and the marine euryhaline *Oithona similis*, *Microcalanus pygmaeus* and *Onceae borealis*) were initially selected as the focus of extensive study because of their numeric importance and their ubiquitous distribution on the Laptev Sea shelf in different seasons of the year.

Material and Methods

During the TRANSDRIFT XX expedition, water and ice samples were collected at three locations: Camp South and Central Camp situated on the fast ice and Camp North located in the polynya area. Water sampling was carried out from boreholes on the ice and was repeated several times at each camp during the expedition. The following biological collections were made and analyzed:

- 28 water samples and 92 ice samples from 7 ice cores were collected for chlorophyll *a* measurements. One liter of water was taken with a Niskin bottle at each standard level

(2 m, 5 m, 10 m ...) at 8 stations. Ice samples (every 10 cm of ice cores) were melted in dark laboratory at a temperature not higher than 4°C. Then the samples were filtered through Whatman glass microfibre filters (GFF) and frozen at -20°C for preservation and transportation. Chlorophyll *a* samples were analyzed on a SPECORD 200 spectrometer and TD-700 fluorimeter in the Russian-German Otto Schmidt Laboratory for Polar and Marine Research (OSL, AARI, St. Petersburg, Russia);

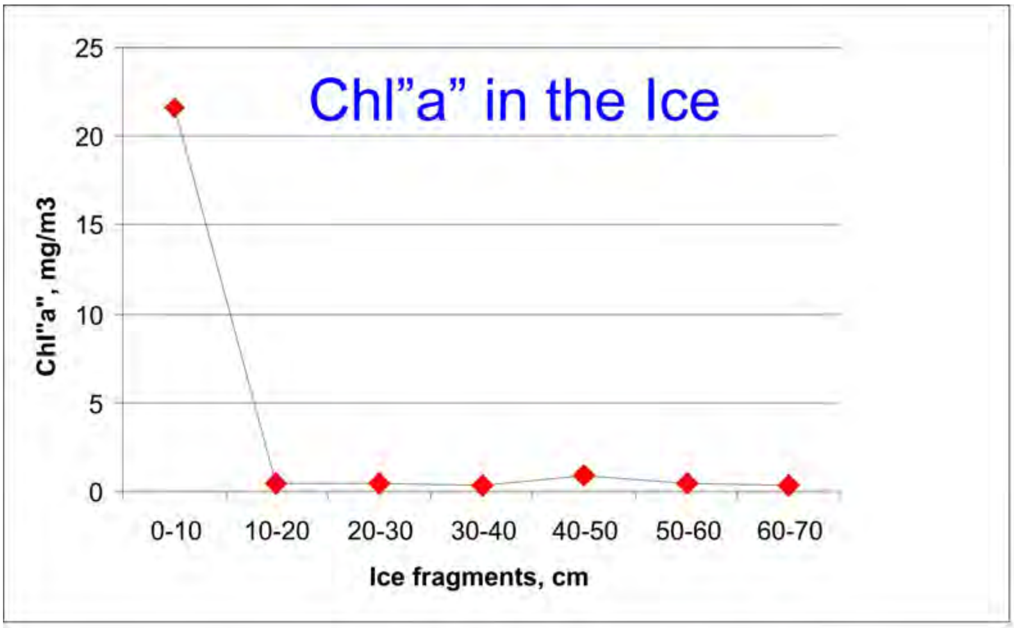
- a small Apshtein net (opening diameter 20 cm, mesh size 100 μm) was used for zooplankton sampling. Nine net catches were made. At each station the net was dipped two times permitting to obtain representative samples. Only total catches were made. Zooplankton samples were fixed with 4% neutral formalin. The preliminary processing of material was carried out under a binocular MBS-10 in the Lena Delta Nature Reserve, Tiksi, during the expedition. Either the whole sample or parts of it were analyzed in a Bogorov chamber. All adult organisms were determined to species level. Juvenile copepods were separated into copepodite stages and identified to species/genus level. Nauplii of the common Copepoda species were counted without species identification. Detailed taxonomic investigations of zooplankton were carried out using the binoculars Olympus SZX9 and BX60 with analyzing system and drawing attachment U-DA in the OSL;
- for investigating the benthic fauna, bottom sediment samples were collected at 4 stations with a Van Veen grab sampler (coverage 250 cm^2). Sampling was carried out through a hole in the ice. The benthos was fixed with 70% ethanol with Rose Bengal for coloring living organisms. The samples will be analyzed in the OSL.

Results and conclusions

At high latitudes, where light limits primary production in the water column for up to 10 months per year, sea ice provides a substrate for algal growth which a number of copepod species exploit.

Recent investigations of zooplankton on the Laptev Sea shelf demonstrate that several Copepoda species and larvae of invertebrates start their growth early by utilizing algae that develop on the under-ice surface several months before the pelagic phytoplankton bloom. Despite low chlorophyll levels in the water column in early spring, we found very high concentrations of chlorophyll *a* in the low part of the ice cores in April 2012. The highest chlorophyll level (up to 22 mg/m^3) was observed in the lower 10 cm of the ice core from station 9 (Fig. 28). It was more than 5 times higher than in the water surface layer in that time and on average 10 times higher than summer chlorophyll concentration in the surface layer in the eastern Laptev Sea.

The data on chlorophyll *a* distribution in the ice and water correlate well with nutrients distribution at the stations of North Camp. Very high phosphate (up to 2.81 µmol/l) and very low silicate concentrations (about 8 µmol/l) were found in the lower 10 cm of the ice core from station 9. The opposite situation with nutrient distribution was observed in the water column at the same station (Fig. 29). Analysis of phytoplankton clearly showed that the maximum concentrations of algae were recorded also in the lower part of the ice cores where the phytoplankton abundance consisted of more than 4,000 cell/ml while the amount of algae in the water column did not exceed 250 cell/ml. Our investigations have shown that the primary production on the Laptev See shelf is not so low and winter productivity of Arctic ecosystems may be equal or some times even higher in comparison with the summer season. It is should be mentioned that the spring phytoplankton bloom connected with the ice starts much earlier than in the water column and provides very good conditions for zooplankton development.



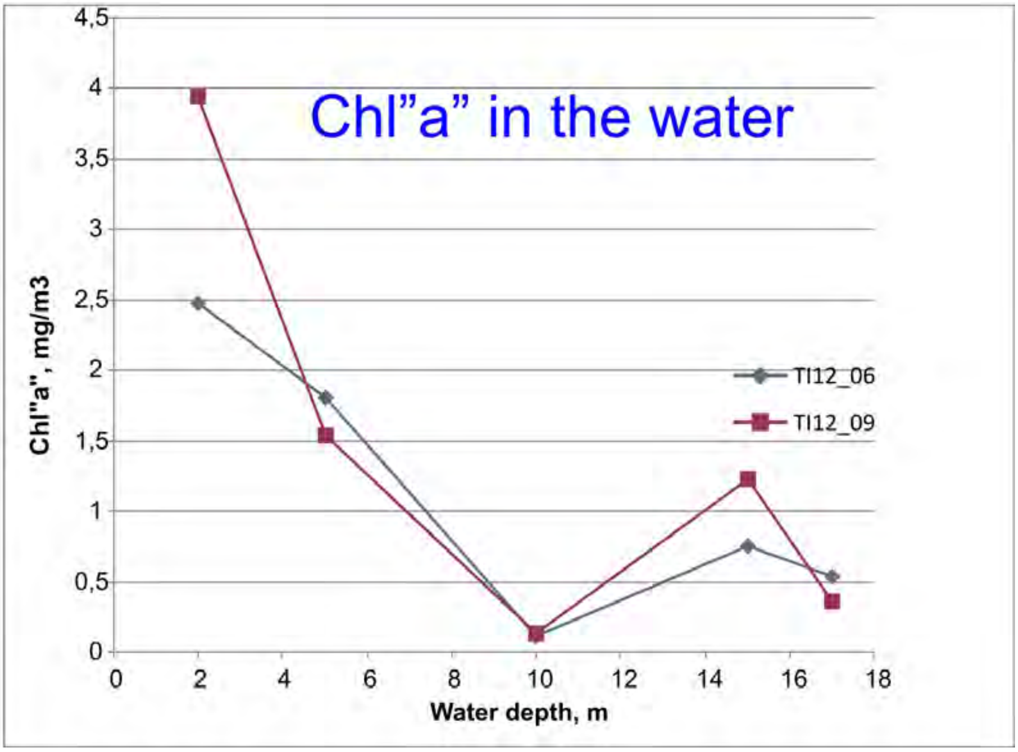


Fig. 28: Distribution of chlorophyll *a* in the ice core at station 9 and in the water column at stations 9 and 6 belonging to Camp North.

23 brackish and marine zooplankton taxa belonging to different groups of invertebrates (Coelenterata, Polychaeta, Chetognata, Echinodermata and Arthropoda (Copepoda)) were determined during the whole period of our investigations in March-April 2012. In spite of a high larvae diversity of Polychaeta and Echinodermata, they are not an important component of the Arctic pelagic community on the Laptev See shelf at this time because of their very low abundance in comparison with the Copepoda species. Among the latter, representatives of the Clausocalanidae family (*Drepanopus bungei* and *Pseudocalanus* sp.) completely dominated

the pelagic fauna on the eastern Laptev See shelf in spring 2012 (Fig. 30). These taxa showed signs of reproductive activity: quite a number had reached an advanced state of gonad maturation, some laid eggs or youngest developmental stages were present in their populations. It seems that these small copepods sustained reproduction with all life stages present throughout the year and constant depth distribution without seasonal ontogenetic redistribution as the *Calanus* species.

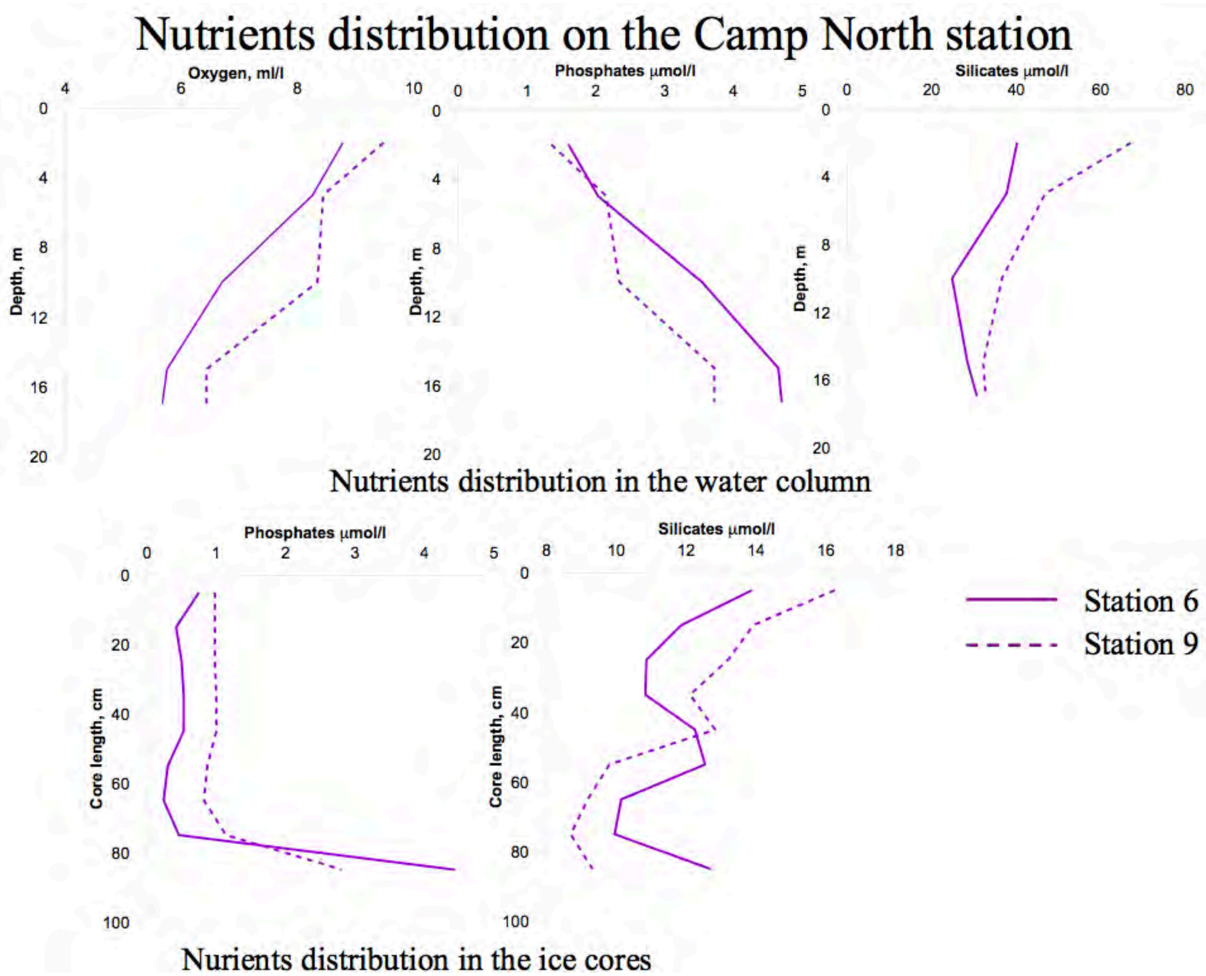


Fig. 29: Oxygen and nutrient distribution in the ice and water at stations 6 and 9 (North Camp).

In spring 2012, the total average zooplankton abundance was very high with the maximum at Camp North with 7,618 ind/m^3. The lowest abundance – 2678 ind/m^3 – was measured at Camp South. This zooplankton abundance is comparable with the summer situation in the pelagic community on the Laptev See shelf. Not only good feeding conditions, but also favorable temperature-salinity conditions promoted the rapid development of the pelagic brackish-water species. The surface salinity was not higher than 22‰ throughout the investigated area. The typical herbivorous brackish-water species *Drepanopus bungei* was especially numerous at that time. The share of small marine copepods (*Oithina similis*, *Microcalanus pigmaeus* and *Onceae borealis*) did not exceed 3% of the total zooplankton abundance. The obtained results yet again demonstrate the strong impact of abiotic factors on the structure and functioning of the pelagic ecosystem in the eastern Laptev Sea.

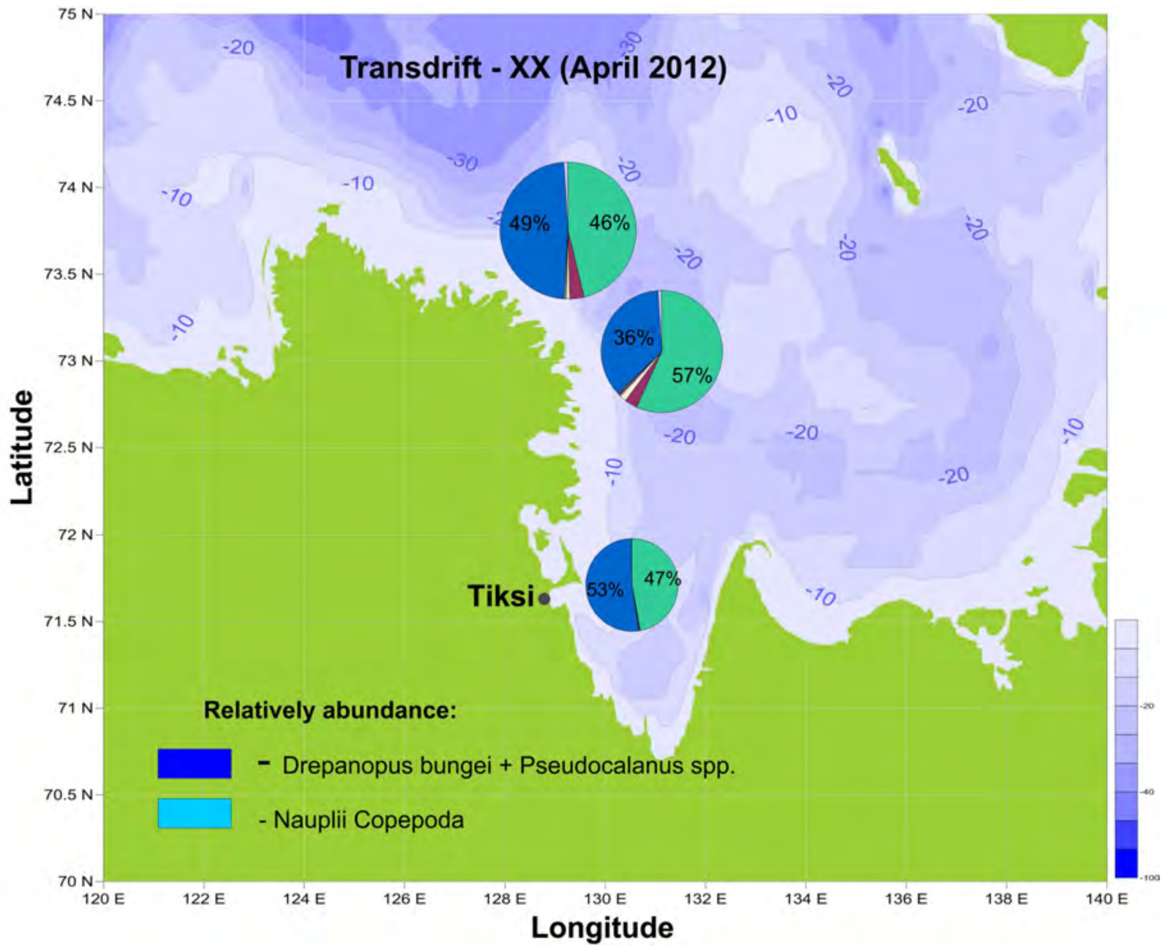


Fig. 30: The total zooplankton abundance distribution and relative abundance of dominant taxa at camps South, Central and North in April 2012.

References

Abramova, E., Tuschling, K. (2005) A 12-year study of the seasonal and interannual dynamics of mesozooplankton in the Laptev Sea: Significance of salinity regime and life cycle patterns. Global and Planetary Change, 48(1-3): pp. 141-164.

Ashajian, C.J., Campbell, R.G., Welch, H.E., Butler, M., Keuren, D.V. (2003) Annual cycle in abundance, distribution, and size in relation to hydrography of important copepod species in the western Arctic Ocean. Deep Sea Research I, 50: pp. 1235-1261.

Conover, R.J., Huntley, M. (1991) Copepods in ice-covered seas - distribution, adaptations to seasonally limited food, metabolism, growth patterns and life cycle strategies in polar seas. Journal of Marine Systems, 2: pp. 1-41.

Hopcroft, R.R., Clarke, C., Nelson, R.I., Raskoff, K.A. (2005) Zooplankton communities of the Arctic's Canada Basin: the contribution by smaller taxa. Polar Biology, 28: pp. 198-2006.

Kosobokova, K.N., Hanssen, H., Hirche, H.J., Knickmeier, K. (1998) Composition and distribution of zooplankton in the Laptev Sea and adjacent Nansen Basin during summer 1993. Polar Biology, 19: pp. 63-76.

Lischka, S., Knickmeier, K., Hagen, W. (2001) Mesozooplankton assemblages in the shallow Arctic Laptev Sea in summer 1993 and autumn 1995. Polar Biology, 24: pp. 186-199.

PHYTOPLANKTON INVESTIGATIONS

I. Kryukova
Institute of Water Problems RAS, Russia

Introduction

The wind-forced Laptev Sea polynya is a major area of sea-ice production in the Arctic, and it is one of the key elements of the environmental system of the Laptev Sea. It is therefore essential to improve our knowledge of the Laptev Sea polynya system as the crucial shelf area with a high level of biological activity, and as a significant contributor to primary production.

According to our data from the two past winter expeditions (TRANSDRIFT XIII and XV), the phytoplankton bloom under the ice and in the ice starts in the Laptev Sea polynya region already in April. The main goal of the biological research during TRANSDRIFT XX was to obtain more information about the question whether there is really a dramatic trend in the spring phytoplankton bloom and the development of the zooplankton community in connection with regional climate changes as well as range shifts and changes in the period of peak biomass on the Laptev Sea shelf. The main objectives are to study the structure and variability of the sea-ice algae and phytoplankton during the spring growing season in the fast-ice zone in the Laptev Sea. It is of interest to assess how the variability in algal communities is related to environmental forcing parameters such as salinity, temperature, nutrient concentrations.

Methods and equipment

Sampling was carried out at a site near the fast-ice edge of the West New Siberian Polynya (Camp North) and at the sites on the fast ice (Camp South and Camp Central) between March 26 and April 19. Sampling was carried out more than once at every camp (twice at Camp South and Central, three times at Camp North). This provides the opportunity of investigating a possible species succession as well as abundance and biomass dynamics. In total 28 water samples, 90 ice samples and 10 net samples were collected during the TRANSDRIFT XX expedition.

Water samples of 1 liter each were collected with a Niskin water sampler at standard water depths (2 m under ice, 5 m, 10 m … and near the seabed) and poured into plastic bottles. The ice samples (every 10 cm of ice core) were melted in the dark laboratory at a temperature not higher than 4°C. The water samples and melted water from ice samples were filtered through nuclear pore filters (1 micron pore size) at a pressure of not more than 0.2 bar. After that the filters were put in plastic bottles and fixed with 4% neutral formalin solution.

Also material for phytoplankton investigation was collected with an Apstein net having a diameter of 20 cm and a mesh size of 20 µm. The samples were taken from the water column between the surface layer under the ice and the pycnocline as indicated by CTD-casts carried out before sampling and between the surface layer and the seabed. The samples were poured into plastic bottles and fixed with 4% neutral formalin solution. Further processing of all samples will be carried out at Lomonosov Moscow State University.

Preliminary results

As preliminary results we can notice that the maximum concentrations of the algae were visually observed in the lower part of the ice cores (Fig. 31). The most intensively colored ice was found at Camp North near the fast-ice edge. The earliest ice bloom was noted visually on

April 10, 2012. At the other stations in the region, we did not see colored ice.

Fig. 31: Ice core sampled at the Camp North on April 17, 2012.

On the basis of the first preliminary microscopic analysis, we conclude that the ice algal biomass was dominated by diatoms. The diatoms in the ice assemblages are mostly chain-forming pennates from the genera Fragilariopsis, Navicula, and Nitzschia. Species of dinoflagellates and green algae are subdominant. Typical spring bloom species (*Nitzschia frigida*, *Navicula pelagica*, *Fragilariopsis cylindrus*) are the major contributors to total algal abundance. The highest abundance and biomass values are observed in the bottom part of the ice cores and in the upper 5-10 m of the water column (Figs. 32, 33). The algal abundance in the bottom part of the ice core is much higher than in the adjacent water column. Further analysis will provide more detailed data on the structure and temporal variability of the sea-ice algae and phytoplankton during the spring growing season in the Laptev Sea.

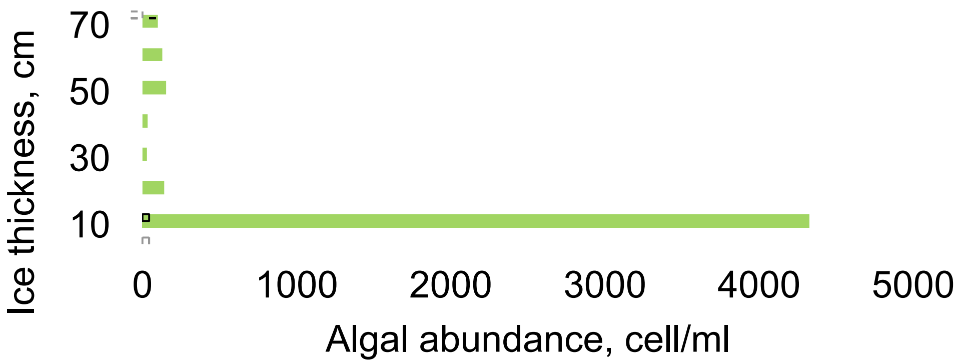


Fig. 32: Vertical distribution of algal abundance in an ice core sampled at Camp North on March 26, 2012.

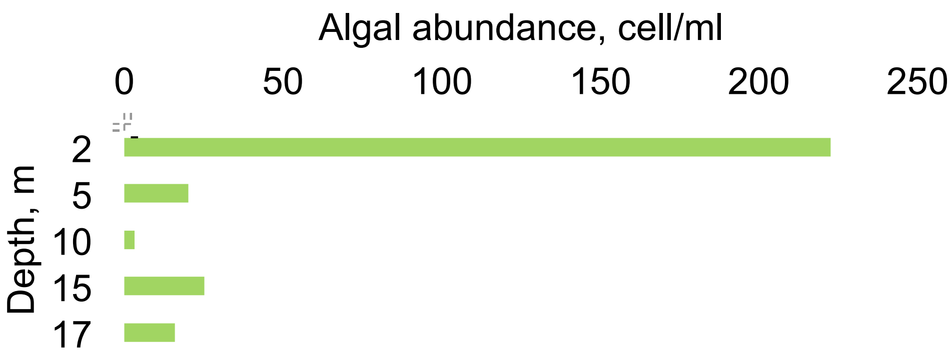


Fig. 33: Vertical distribution of algal abundance in the water column at Camp North (sampling was carried out on April 10, 2012).

THE BEARING CAPACITY OF THE LANDFAST ICE OF THE LAPTEV SEA

I. Sheikin, L. Panov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Objectives

The bearing capacity of the sea-ice cover depends on many factors that control ice-deformation and ice-failure processes. Therefore, the field program included various measurements of the physical and mechanical properties of sea ice, which are needed with respect to giving a proper estimate of the bearing capacity. Usually, some calculations are based on empirical equations. Field observations and experiments naturally make this kind of analysis more reliable. The bearing capacity of ice was monitored also with the operative control of the ice deflection under heavy loads.

Our tasks are to

- evaluate the structure of the ice cover (texture, crystal structure);
- evaluate the physical properties of ice (temperature, salinity, density);
- test the strength limit of ice samples at compression and flexure;
- carry out tests of strength of level ice *in situ*;
- carry out measurements of the ice deflections under stationary and moving loads using a helicopter MI-8 and a KAMAZ truck.

Ice sampling

During the field program, 24 ice cores were taken for analysis and tests using electromechanical drills (from the company “Kovacs Enterprise”, USA, core diameters are 9 and 14 cm) and mechanical manual drills from Cherepanov (core diameters 18 cm).

Table 7 presents general information about ice cores.

Table 7: Data of the obtained ice cores

Date	Station	Scope	Size (mm)	Drill equipment
26.03.2012	1201	1	140*750	Covacs drill
27.03.2012	1202	3	140*1350	Covacs drill
04.04.2012	1203	2	220*1650	manual drill
10.04.2012	1206	3	220*860	manual drill
10.04.2012	1206	8	90*860	Covacs drill
12.04.2012	1207	1	220*159	manual drill
12.04.2012	1207	6	90*100	Covacs drill

size = diameter length

Boreholes for test operations of ice strength *in situ* by a borehole jack were prepared using a motor drill 225AI 25 from the company “Husqvarna” (Sweden). Figure 34 presents a view of drill equipment. Because of low air temperatures, the chain saw “STIHL-88” was destroyed during the field works and we could not use this equipment for ice sampling.

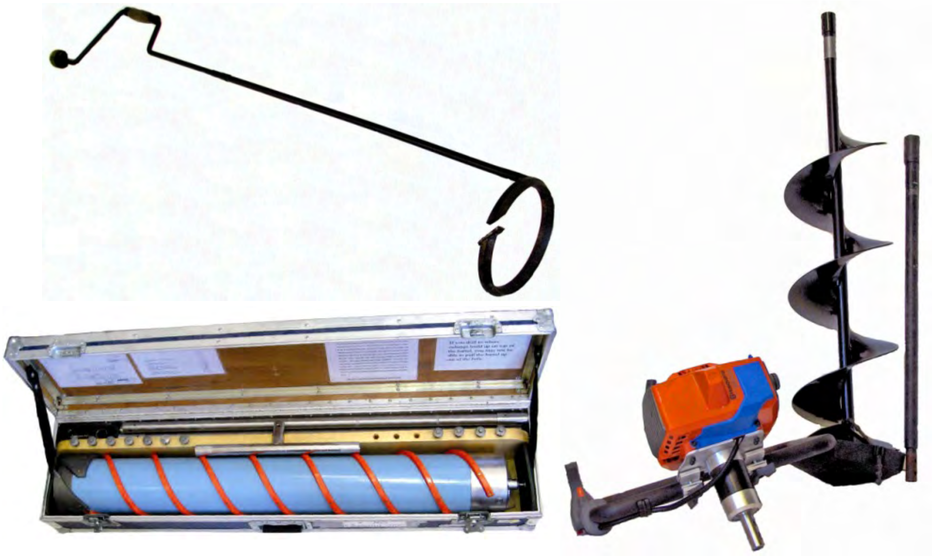


Fig. 34: View of drilling equipment. Manual drill of Cherepanov (top left), electromechanical drills from Kovacs Enterprise (bottom left), and Motor drill 225AI 25 from Husqvarna (right).

Evaluation of texture and crystal structure of ice

Ice texture was evaluated on the basis of visual examination of the five ice cores. For texture analysis we used also pictures of ice disks that were prepared for the flexural-strength tests in the laboratory (about 100 pictures). The following features are marked:

- transparency of ice, color (for non-transparent ice);
- presence of air and salt inclusions in the ice, their shape and size;
- presence of mineral (sand, clay, sludge) and organic inclusions in the ice.

For the ice structure analysis, 39 thin sections with a thickness of about 1 millimeter from four ice cores were prepared using a manual knife in the cool laboratory. These ice sections were positioned between polarized glasses in a special table. The ice crystals, their sizes and orientations were fixed on digital pictures in cross-polarized light. Some polarized pictures of thin vertical and horizontal sections are presented together with an ice-core picture in Figure 35. Table 8 presents general information about the ice cores selected for the ice-texture and structure analysis.

Table 8: Data of the ice cores selected for the ice-texture and structure analysis

Date	Station	Size of ice core (mm)	Number of thin sections
26.03.2012	1201	140*750	11
27.03.2012	1202	140*1350	11
04.04.2012	1203	~300*1650	11
10.04.2012	1206	220*860	6
12.04.2012	1207	220*159	-

*size = diameter*length

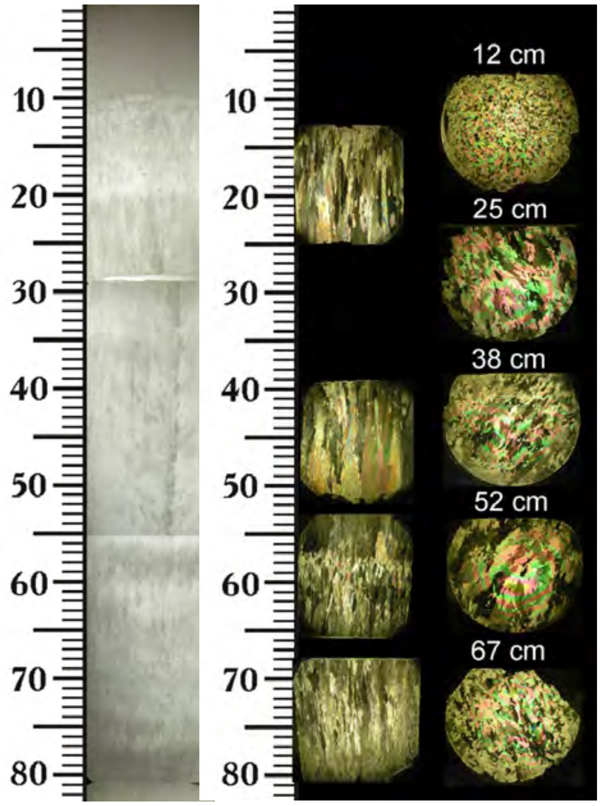


Fig. 35: A composite picture of an ice core (left) and pictures of thin-ice sections in polarized light (right); station 1202, March 27, 2012.

Evaluation of temperature, salinity and density of ice

Ice temperature measurements were performed *in situ* using an electric thermometer GTH 175/MO from Conrad Electronics with an accuracy of 0.1°C (see Fig. 36). The 23 measurements were made in two ice cores immediately after taking them and 29 measurements were made in natural ice on the bottom of the holes prepared with the Husqvarna motor drill. The latter method yields precise results up to depths of about 80 cm. Figure 4 presents an example of temperature measurements using both methods.

The ice salinity measurements were made with an electrical conductometer HI 8733 from Hanna Instruments (see Fig. 36) in the water that melted from pieces of the ice plates after the flexural-strength tests in the laboratory. About 300 measurements of ice salinity were performed in the lab for the six ice cores with a depth resolution of 20-25 mm and an accuracy of 0.1 ppt. Figure 37 shows the good correlation of the salinity data obtained from two ice cores from the same place.

Ice density was evaluated in the laboratory by weighing the ice plates before the flexural-strength tests using electronic scales MK-3.2-A20 from Conrad Electronics (see Fig. 36) with an accuracy of 0.01 N. The volume of the samples was estimated on the basis of measurements of the diameter and thickness of the ice plates. About 300 measurements of ice density were carried out for the six ice cores with a depth resolution of 20-25 mm and an estimated accuracy of about 1%.

Fig. 36: Equipment for measurements of ice temperature, density and salinity; left: electric thermometer GTH 175/MO (Conrad Electronics), center: electronic scales MK-3.2-A20 (Conrad Electronics), and right: electrical conductometer HI 8733 (Hanna Instruments).

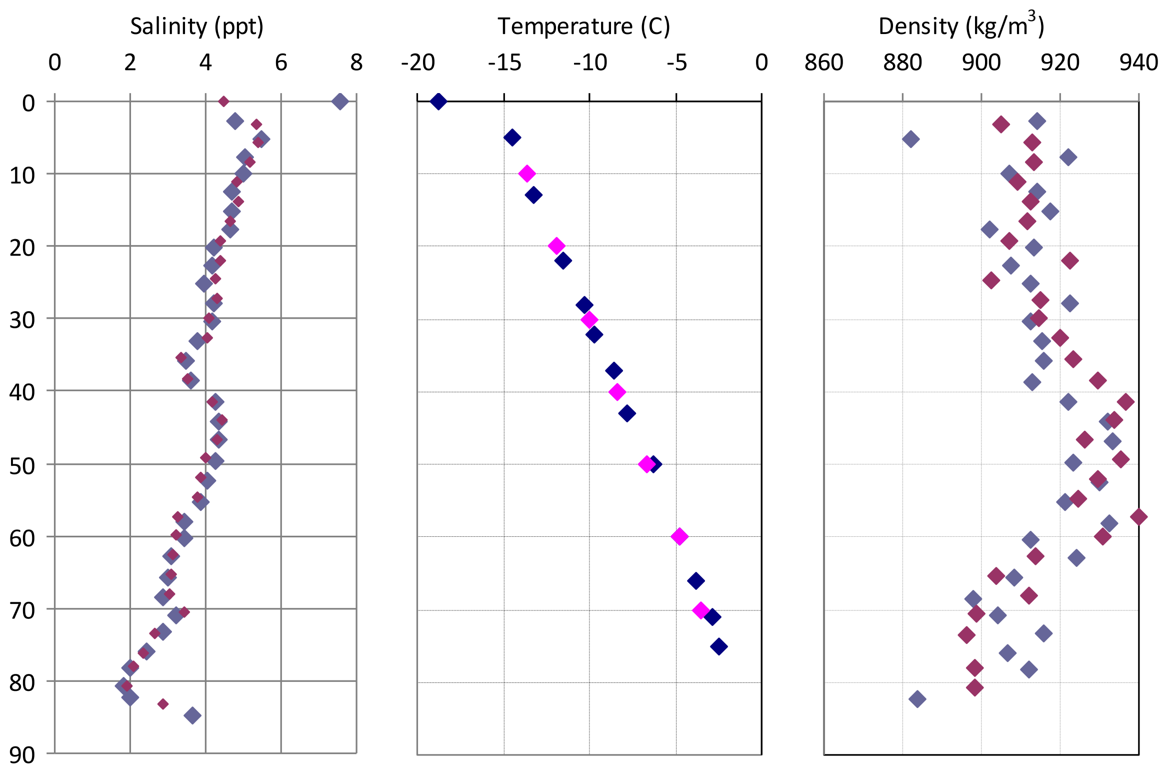


Fig. 37: Ice salinity, temperature and density versus depth (cm); station 1206, April 10, 2012.

Evaluation of ice strength at compression

Tests of ice samples for uniaxial compression are carried out using a hydraulic press LGK021 with an electrical pump. At the pressure of up to 20 MPa, the hydraulic system generates a working load in the press of up to 1.6 kN. A hydraulic piston penetrates into the ice with a constant rate about of 5 mm/s, which corresponds to the ice-deformation rate of 0.025 s^{-1}. A digital system measured the pressure inside the hydraulic cylinder (P_c) with an accuracy of 0.05 MPa. The working pressure inside the ice samples (P_w) was calculated using the simple equation:

$$P_W = P_C \cdot \frac{D_C}{D_W}$$

where D_c and D_w are the diameter of the hydraulic piston and the diameter of the ice samples, respectively. Cylindrical ice samples with a diameter of 9 cm and a length of 20 and 24 cm are selected from the level ice using an electromechanical drill from Kovacs and a manual saw. Figure 38 presents a view of the press LGK021 as well as a sketch of ice sampling.

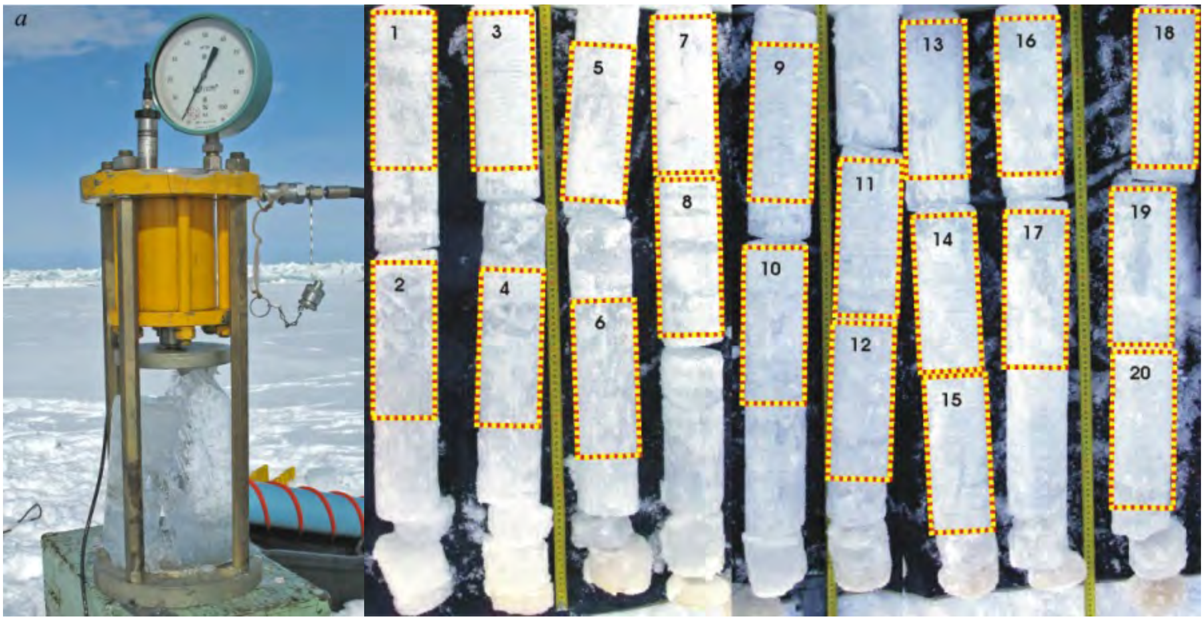


Fig. 38: View of the press LGK021 and sketch of ice sampling for the tests; station 1206, April 10, 2012.

During the field works, 20 tests of ice samples were carried out at the station 1206 and 19 tests at station 1207 on April 10, 2012. Figure 39 presents an example of the test pressure records. The initial pressure peaks are the structural strength of the ice samples. The secondary pressure peaks with high maxima reflect the mechanical strength of the ice crystals. However, there are difficult to estimate their actual value because the total contact area of the ice crystals is unknown.

Evaluation of flexural strength of ice samples in round plates

Tests of ice samples for flexure are carried out using a field machine PIM-200 (Fig. 40) that includes a measured table with a mechanical lifting system in the bottom and a spring sensor of the loads (dynamometer) with an arrow indicator in the top. Ice plates with a diameter of 18 or 13.8 cm and a thickness of about 2 cm are made from the cores, obtained using a drill from Covacs or a manual drill. About of 300 flexural tests were carried out in the labatory for the six ice cores with an accuracy about of 5%. The limit stresses at ice failure were estimated on the basis of a mathematical model that gives the following equation for ice plates with a diameter of18 cm:

$$\sigma_{\max} = 2.23 \cdot \frac{P}{h^2}$$

where P is the measured load (kg) and h is the thickness (cm) of the ice plate. Two independent depth profiles of the flexural strength on the diagram in Figure 7 indicated a significant increase in the flexural strength in the bottom of the ice cover. Probably this is connected with the organic inclusions in the ice.

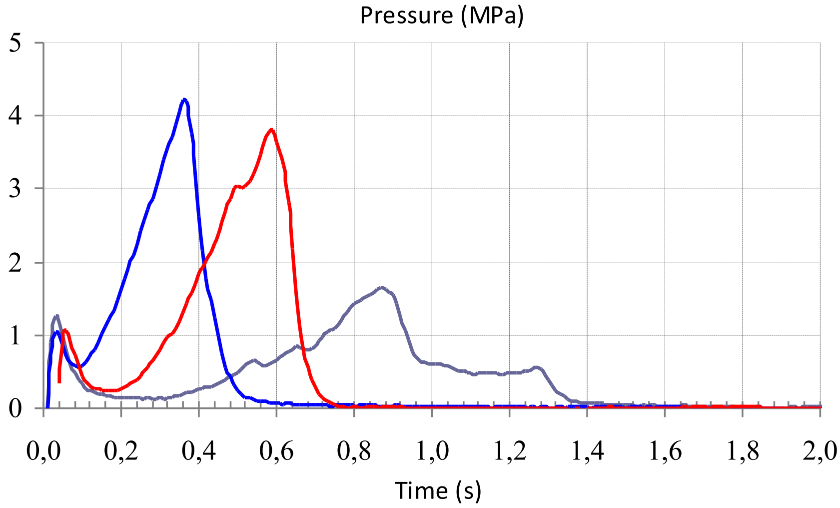


Fig. 39: An example of test pressure records.

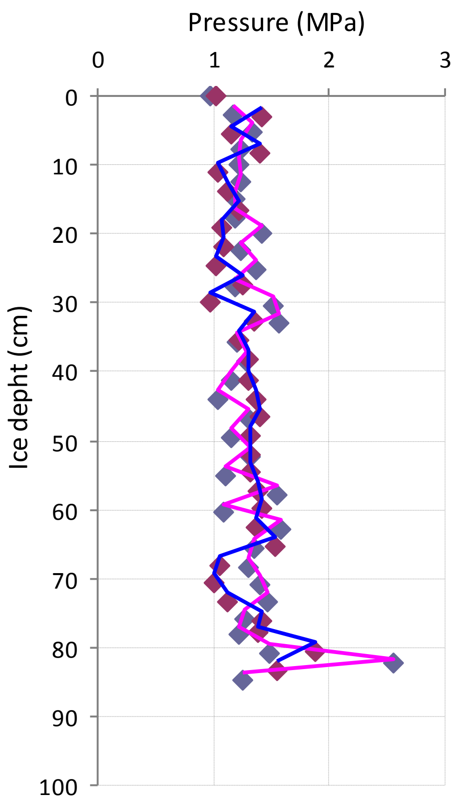


Fig. 40: View of the field machine PIM-200 (left) and the flexural strength of the ice samples versus ice depth, station 1206, April 10, 2012 (right).

Table 9 presents general information about the location and scope of work with respect to the flexural-strength tests.

Table 9: Location and scope of work with respect to the flexural-strength tests

Date	Station	Size	Numbers of tests
27.03.2012	1202	140*1310mm	58
27.03.2012	1202	140*1040mm	43
27.03.2012	1202	140*500mm	19
04.04.2012	1203	220*1670mm	49
10.04.2012	1206	220*860mm	32
10.04.2012	1206	220*860mm	31
12.04.2012	1207	220*1590mm	63

*size = diameter*length

In situ evaluations of ice compression strength (borehole jack tests)

For the evaluation of local ice strength *in situ* in the borehole a hydraulic borehole jack indentor with an electrical pump were used (Fig. 41). The preliminary tests indicated that the large indentor with a diameter of about of 90 mm penetrated very slowly into the ice. Therefore the large intentor was replaced by a small indentor with a diameter of about of 65 mm. The measurements were made inside the boreholes at various depths. However, the distance between the loading points should be more than 40 cm. Therefore, in the thin ice of Camp North every borehole was included in one test only. Some holes were dry and others filled with seawater and brine. During the tests a digital data system fixed the working pressure in the hydraulic system and the time of penetration.

Fig. 41: View of the borehole-jack equipment with the electrical hydraulic pump.

About 80 tests were carried out during the field works at the stations 1203, 1206 and 1207. Figure 42 presents an example of the records of the borehole-jack tests.

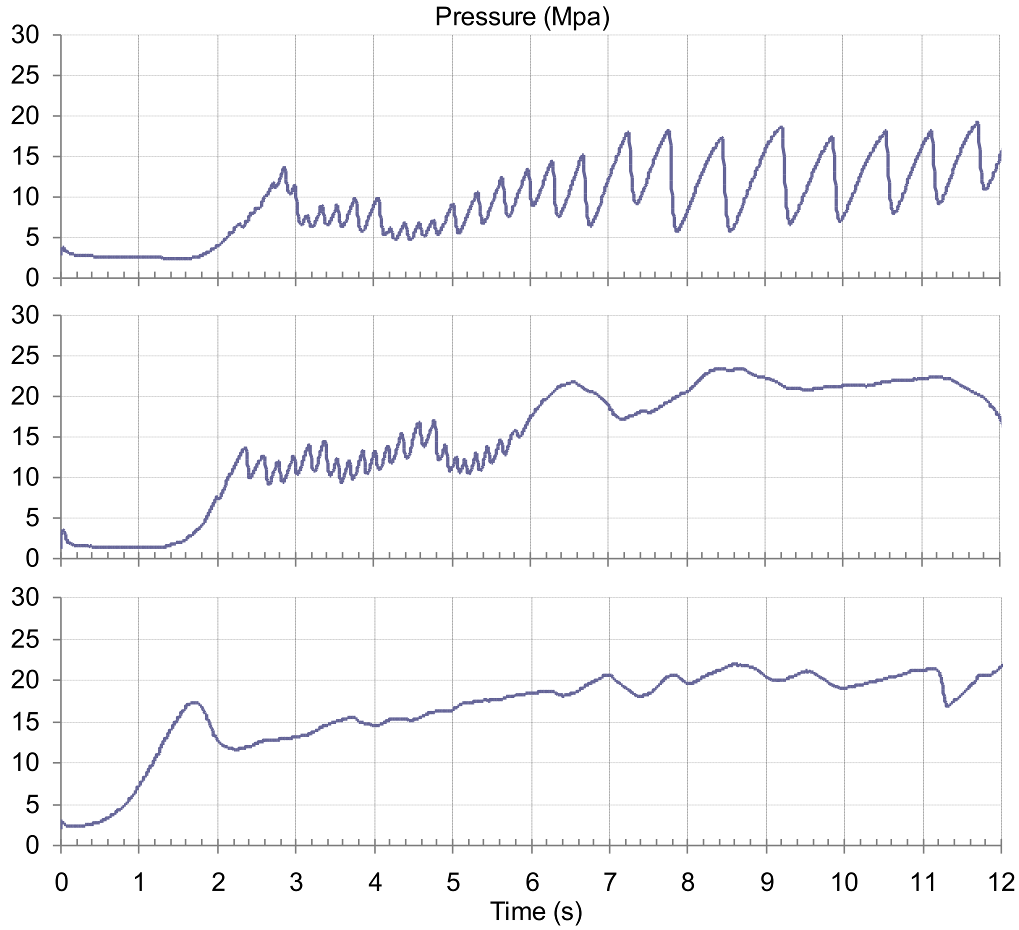


Fig. 42: Example of the records of the borehole-jack tests.

Evaluation of ice deflection under stationary and moving loads

Stationary deflections of the ice cover were measured with the help of an automatic level and a geodetic survey on two ice polygons – station TI-1203 on April 2 and station TI-1206 on April 10. We used an optical automatic level AL-132 of BEIJING BOIF INSTRUMENT CO. LTD to establish our checkpoints on the same horizontal plane. The measured polygon includes two perpendicular lines with 37 reference points at 3-m sample interval (see sketch in Fig. 43).

The ice-thickness, snow-thickness and freeboard measurements were carried out for every second of the reference points on the polygon. These data are presented in Tables 10 and 11. A significant snow cover in the southeastern sector of the polygon (points y12, y18 and y24) generated a respective reduction of ice thickness and freeboard height. This demonstrates that snow accumulation on the ice surface is one of the important factors for the bearing capacity of the ice cover.

Table 10: Ice morphometry on the polygon line X, station TI-1203

Reference points	X6	X12	X18	X24	X-6	X-12	X-18	X-24	XY0
Ice thickness, cm	166	165	163	163	164	165	166	166	167
Snow thickness, cm	5	3	4	3	5	6	5	7	2
Freeboard, cm	14	13	14	15	14	14	16	17	14

Table 11: Ice morphometry on the polygon line Y, station TI-1203

Reference points	Y6	Y12	Y18	Y24	Y-6	Y-12	Y-18	Y-24
Ice thickness, cm	168	169	163	168	166	163	162	154
Snow thickness, cm	2	2	5	4	6	12	18	24
Freeboard, cm	15	13	13	15	13	11	12	7

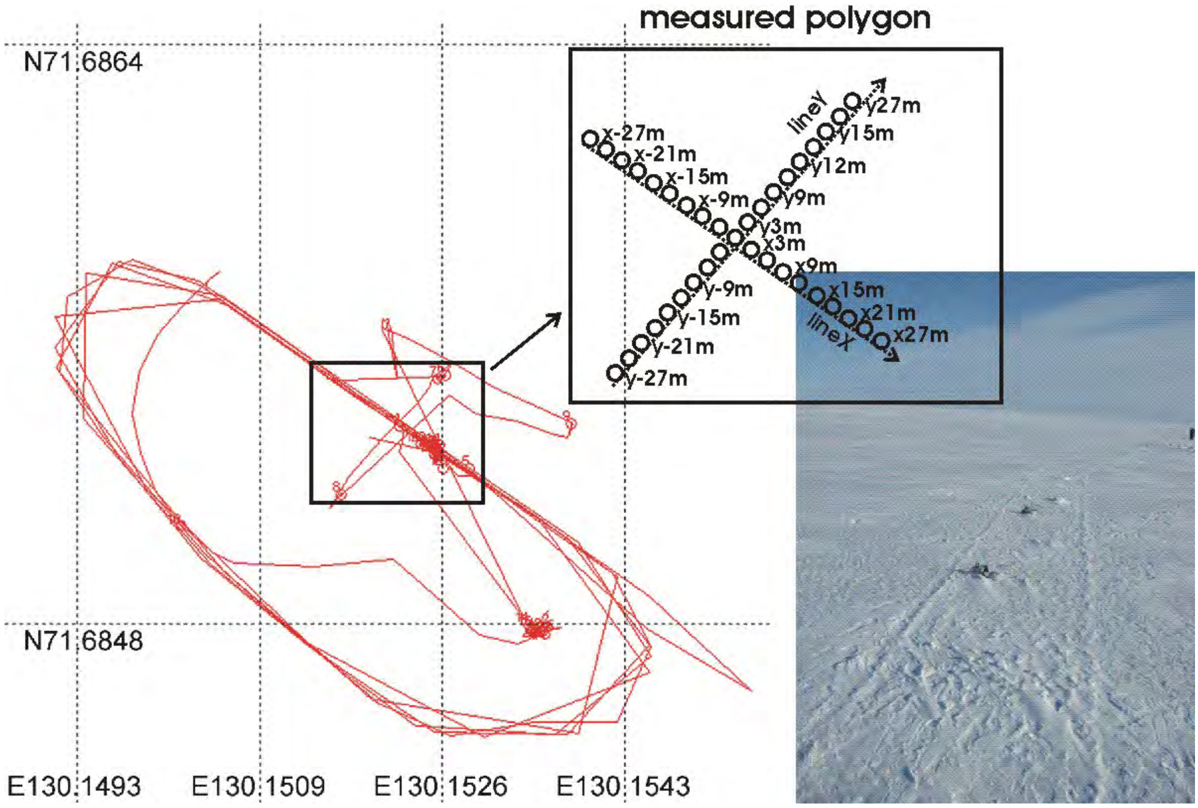


Fig. 43: Measured polygon for studying the stationary and dynamic deflections of the ice cover under the KAMAZ load. The red line is a KAMAZ track across the polygon during the experiment in motion. The photograph on the right is a view of the X-line with seismic equipment from the KAMAZ cabin.

Two preliminary surveys were carried out on the unloaded polygon after ice morphometry measurements. It is shown that the level measurement error consists of about 2-3 mm on the distance of up to 50 m for the actual conditions. The large geodetic errors are connected with the high level of seismic activity in the landfast ice that was monitored using seismic equipment. This moment corresponds to the time interval of 6-10 hours in Figure 44, when the vertical displacements of the ice cover were about 2 mm. On the next day, the respective measurement errors decreased up to 1-2 mm because of a reduction of the seismic activity in the landfast ice.

After the series of experiments with a moving load, the KAMAZ was positioned in the position over the central point of the polygon along the X-line, where it stayed until departure to the shore. Four series of geodetic surveys were carried out during the next two days.

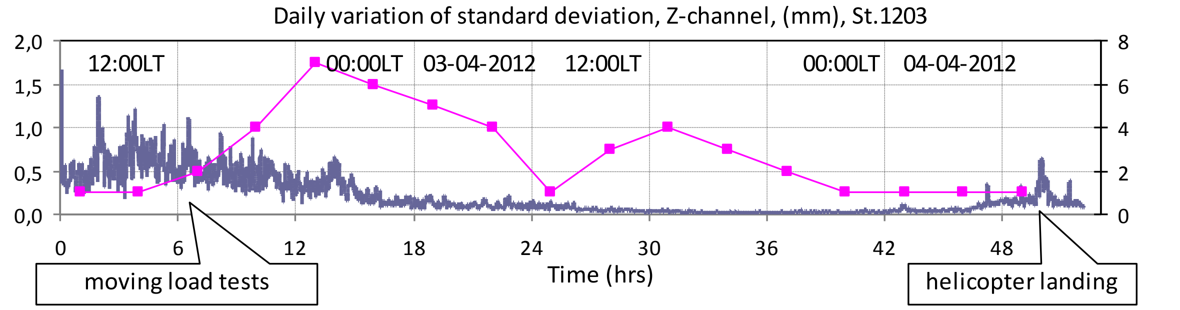


Fig. 44: Long-term variations of seismic activity in the landfast ice, station 1203. Wind speed from Tiksi meteostation is given in the additional axis on the right.

The second series of bearing capacity measurements with stationary loads were carried out on April 10 at the northern station TI-1206 under the conditions of relative thin landfast ice in the vicinity of the polynya. The small polygon included one measured line in west-east direction with 13 reference points. The ice thickness changed from 80 cm on the eastern endpoint x18m to 84 cm on the central point and up to 86 cm on the western endpoint x-18m. Probably some distribution depends on the snow cover, the thickness of which was a little bit more in the direction of the ice ridges.

As stationary load we used a helicopter MI-8 with ean stimated weight of about 10 tons. At 13:25 LT after finishing the work flight over the polynya and the neighboring areas, the helicopter landed on the prepared and measured polygon. Two double series of geodetic surveys were performed during the next work step until departure. Figure 45 presents the averaged profiles of difference heights as well as respective trend lines in parabolic approximation. The first profile was made half an hour after helicopter landing and the second 3 hours later.

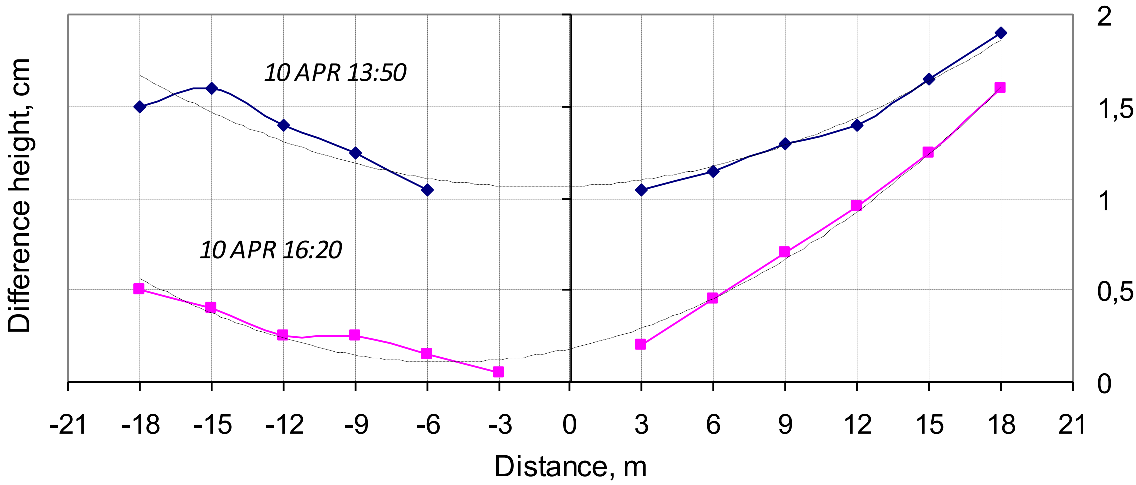


Fig. 45: Two averaged profiles of geodetic surveys on the northern polygon, April 10, 2012, station 1206, local time.

Both polygon experiments indicated a predominance of elastic ice deformations for the short-term deflections and of plastic deformations for the long-term deflections.

Using seismic equipment on the southern polygon (station TI-1203) we investigated ice deflection under a moving load, various waves that are induced by a moving car as well as natural waves in the ice cover. Figure 46 presents a modern seismometer SME-041E with digital loggers that were deplloyed on the measured road along line X in the vicinity of the reference points x9 and x15 (see Fig. 43). Each of the two seismometers measured three components of seismic oscillations. As moving load we used a KAMAZ with an estimated weight of about 14 tons, which were distributed between three pairs of wells in the ratio of 6 to 4 to 4, where 6 tons is the load on the forward pair of wells and 4 tons on every of the rear pairs. In the cabin of the KAMAZ a GPS logger was established, which recorded the position and speed every 10 second. The red line in Figure 43 demonstrates a circular GPS track of the KAMAZ during the experiments with a moving load. In the first three tests the KAMAZ moved across the polygon in southeast direction with a constant speed of 4, 10 and 15 km/hour and in the final three tests the KAMAZ moved across the polygon in northwest direction with a respective speed of 5, 16 and 26 km/hour.

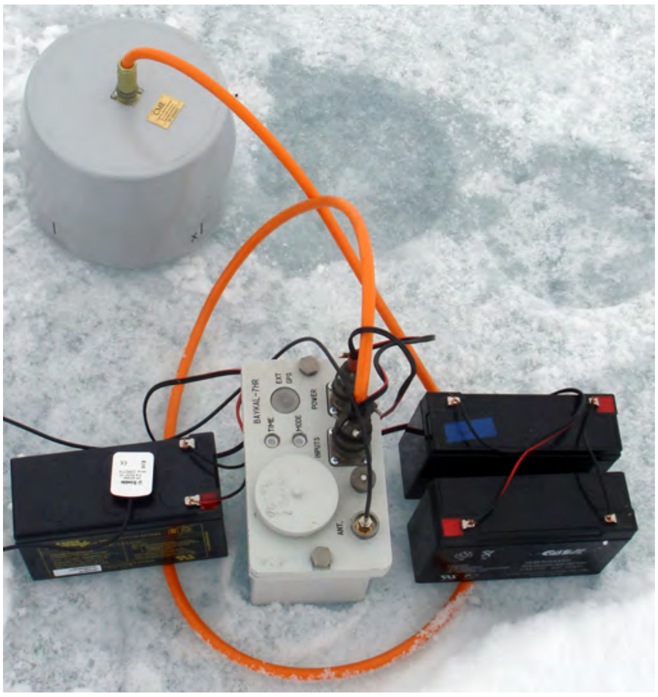


Fig. 46: View of the seismometer SME-041 with digital loggers.

Figure 47 shows an example of the seismic record during the first experiment when the KAMAZ moved with the minimal speed of about 4 km/hour.

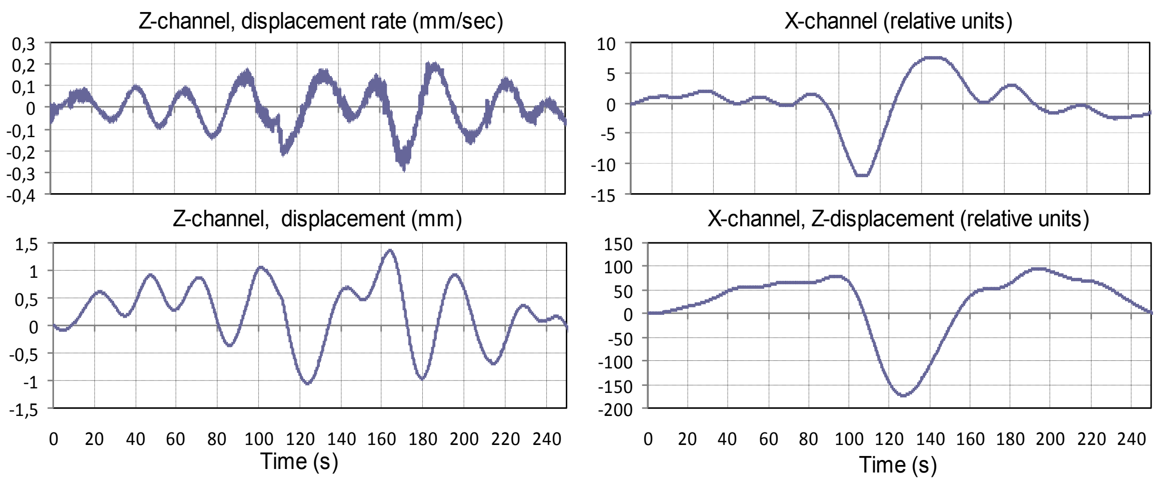


Fig. 47: Seismic response of the ice cover to the moving KAMAZ, speed 4 km/hrs.

During the survey of the southern and northern polygons, a seismic logger recorded the flexural waves and deflection of the ice cover under aerodynamic forces and helicopter weight. At the southern station TI-1203, the helicopter landed in the distance of about 100 m from the measured point. Therefore, the long flexural waves in the range of about 30 s are predominant in the seismic response to this event. At the northern station TI-1206, the helicopter landed in the vicinity of the point of measurements. In this case, the seismic response included both flexural waves and deflection of the ice cover. Figure 48 presents the seismic records during helicopter landing as well as a GPS track of the helicopter flight.

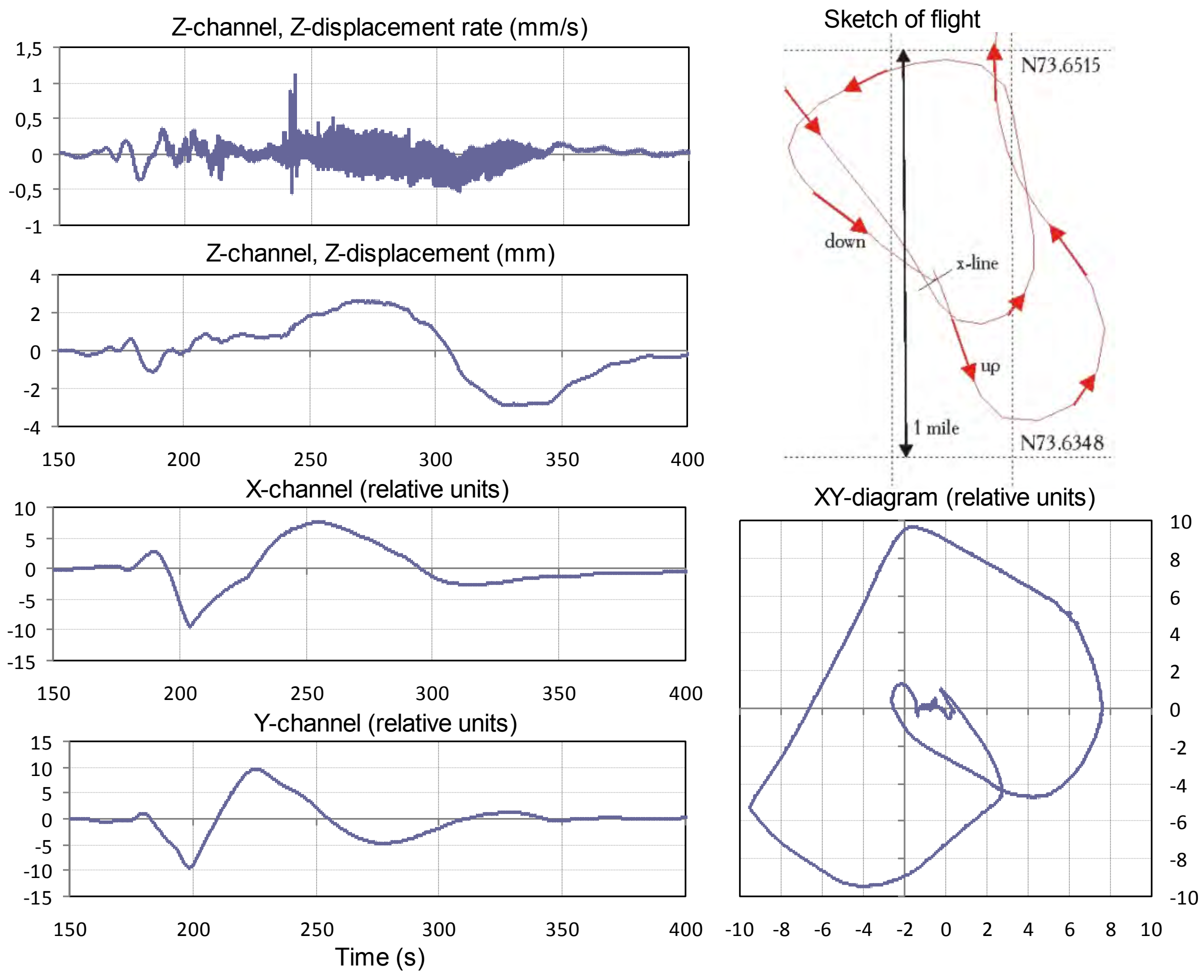


Fig. 48: Seismic response of the ice cover to the helicopter landing and GPS track of the helicopter flight (top right).

At the "upward" flight, the helicopter started from a position (13:01:03 LT) at the distance of about 50 m, and moved across the X-line of the measured polygon with an altitude of about 25 m and a speed of about 30 km/h. The vertical displacements in the Z-channel indicated a maximum value of ice deflectios under aerodynamic forces of about 2.4 mm.

At 13:25:50, the helicopter landed in the central position of the polygon and the Z-channel indicated a maximum value of the ice deflections under the joint influence of aerodynamic forces and helicopter weight in the range of 5.6 mm. This value is in good agreement with the measured ice deflection under stationary loads as well as with the results at the "upward" flight.

Evaluation of seismic activity of landfast ice

Seismic observations were carried out at four stations using modern seismometers SME-041E with digital loggers, which recorded the three channels (X,Y, Z) of seismic processes in the range of 0.02-50 Hz (see Fig. 13). There are short records with lengths of a few hours during the helicopter stations TI-1201, TI-1202, and TI-1206 as well as one long record with two days' duration at the southern station TI-1203.

For the actual conditions the natural seismic activity in the landfast ice is comparable with the seismic response induced by the moving KAMAZ and helicopter. Figure 49 presents a typical example of the seismic processes in the landfast ice. A maximum of seismic activity in the landfast ice corresponds to the magnitude of 3.5 balls according to the Richter scale for earthquakes.

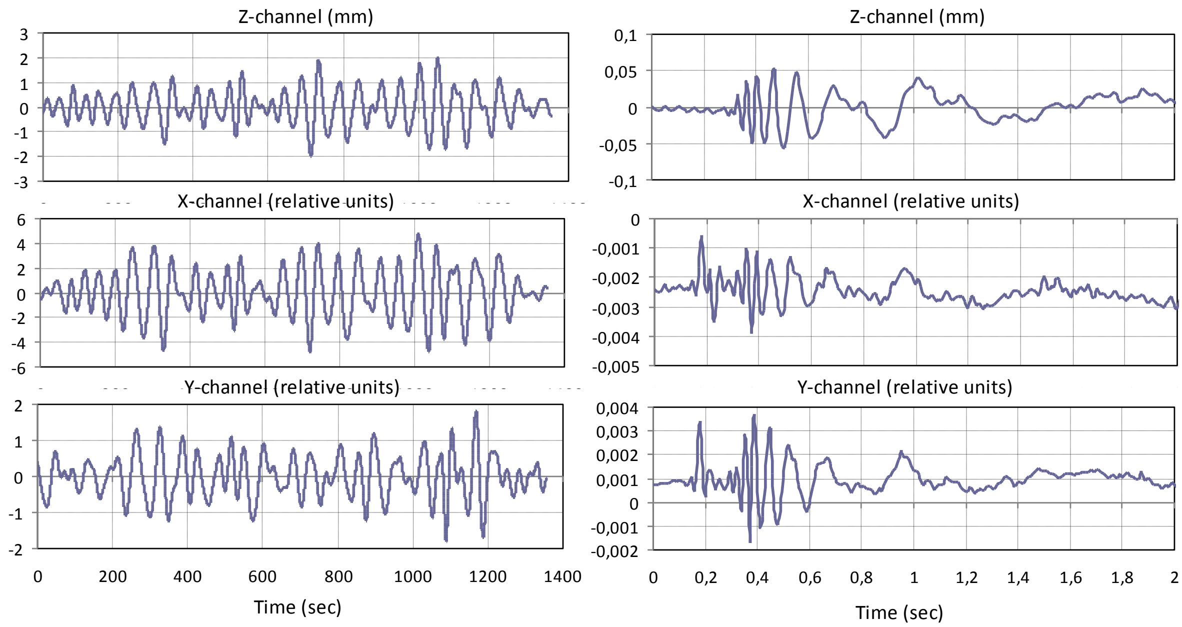


Fig. 49: Examples of natural seismic processes in the ice cover, station 1203: gravity and flexural waves (left) and seismic response to the cracking due to temperature (right).

APPENDIX

- List of participants
- Station list
- Press releases
- Daily reports
- Letter from the Head of the Department of Sciences and Education of the German Embassy in Moscow

List of participants

LIST OF PARTICIPANTS

No.	Name	Affiliation
1	Abramova, Ekaterina	Lena Delta Nature Reserve
2	Birgelen, Georg	German Embassy Moscow
3	Birgelen, Sibylle	German Embassy Moscow
4	Gukov, Alexandr	Lena Delta Nature Reserve
5	Heinz, Karsten	German Embassy Moscow
6	Helbig, Alfred	Trier University
7	Hölemann, Jens	Alfred Wegener Institute for Polar and Marine Research, Bremerhaven
8	Juhls, Bennet	GEOMAR l Helmholtz Centre for Ocean Research Kiel
9	Kassens, Heidemarie	GEOMAR l Helmholtz Centre for Ocean Research Kiel
10	Kirillov, Sergey	Arctic and Antarctic Research Institute, St. Petersburg
11	Klagge, Torben	GEOMAR l Helmholtz Centre for Ocean Research Kiel
12	Kramer, Daniel	Trier University
13	Krumpen, Thomas	Alfred Wegener Institute for Polar and Marine Research, Bremerhaven
14	Kryukova, Irina	Moscow State University
15	Novikhin, Andrey	Arctic and Antarctic Research Institute, St. Petersburg
16	Panov, Leonid	Arctic and Antarctic Research Institute, St. Petersburg
17	Selyuzhenok, Valeriya	Arctic and Antarctic Research Institute, St. Petersburg
18	Sheikin, Igor	Arctic and Antarctic Research Institute, St. Petersburg
19	Taldenkova, Ekaterina	Institute of Water Problems, Russian Academy of Sciences
20	Vizitov, Viktor	Arctic and Antarctic Research Institute, St. Petersburg

Station list

Station		Date	Time (Tiksi)	Latitude (°N)	Longitude (°E)	Water depth (m)	Activity	Ice thickness	Weather	Comments
TI 12 01		26.03.12	12:15	73°38'34,6	128°43'40,7	17,4	Begin	80 cm	-29°, sunny	CAMP NORTH, Polynya
	-1						Meteorological station MISHKA I		12 m/s, E	
	-2						CTD			
	-3						Mooring CAMP NORTH			
	-4						Ice physics			
			16:34				End			
TI 12 02		27.03.12	11:31	73°20'30	130°40'13,7	24	Begin	130 cm	-29°, sunny	CENTRAL CAMP, fast ice
	-1						CTD		12 m/s, E	
	-2						Mooring CENTRAL CAMP			
	-3						Hydrochemstry			
	-4						Biology			
	-5						Ice physics			
			17:07				End			
TI 12 03		01.04.12	18:25	71°41'51	130°09'12,8	10	Begin	170 cm	-20°C, sunny	4-day truck station
	-1						Ice physics			CAMP SOUTH, fast ice
	-2						Meteorology			
		04.04.12	16:00				End			
TI 12 04		03.04.12	13:15	73°20'30	130°40'13,7	24	Begin	130 cm	-24°C	CENTRAL CAMP
							Ice-drill recovery (KOVAX)			without success ice-drill lost
				73°31'25,6	129°32'38,1		EM-Bird calibration fligth			canceled power supply problems
			19:30				End			
TI 12 05		04.04.12	10:52	71°41'38"	130°09'09"	11	Begin	164 cm	-23°C, sunny	CAMP SOUTH, fast ice
	-1						Meteorological station "Mishka II"			Photo P4041269 - P4041283
	-2						CTD			
	-3						Hydrochemistry			
	-4						Biology			
			15:53				End			

Station		Date	Time (Tiksi)	Latitude (°N)	Longitude (°E)	Water depth (m)	Activity	Ice thickness	Weather	Comments
TI 12 06		10.04.12	11:18	73°38'34,2	128°43'37,3	17,5	Begin	90 cm	-22°C	CAMP NORTH, very active Polynya
	-1						CTD		107°, 4,9 m/s	
	-2						Hydrochemistry			
	-3						Biology			
	-4						Ice physics			
	-5						Methane profiling			In cooperation with V.I. Il'ichev Pacific Oceanological Institute RAS
	-6						Photo and temperature profiling (KT 15)			WP 1: 128°40'41,3'' E, 73°39'25,0'' N WP 2: 128°47'56,1'' E, 73°44'02,9'' N WP 3: 128°40'41,3'' E, 73°39'25,0'' N
			16:40				End			
TI 12 07		12.04.12	11:46	73°20'30	130°40'13,7	24	Begin	130 cm	-20°C	CENTRAL CAMP
	-1						CTD			
	-2						Hydrochemistry			
	-3						Biology			
	-4						Ice physics			
	-5						Recovery mooring CENTRAL CAMP			
	-6		17:20				Start Temperature profiling (KT 15)			WP 1: 130°40'13,7 E, 73°20'30,0 N WP 2: 130°00' E, 73°00' N
			17:44				End			
TI 12 08		16.04.12	12:30	73°38'34,2	128°43'37,3	17,4	Begin	80 cm	-20°C, sunny	CAMP NORTH
	-1						Recovery MISHKA I			Sea-ice-thickness survey: NE off Lena Delta
	-2			73°38'34,2	128°43'37,3		EM-Bird, photo and temperature profiling			WP 1 128° 43' 40.0 E 073° 38' 34.6 N WP 2 128° 42' 06.2 E 073° 43' 10.5 N WP 3 128° 43' 40.0 E 073° 38' 34.6 N WP 4 129° 32' 15.3 E 073° 31' 26.7 N WP 5 130° 40' 14 E 073° 20' 28.6 N WP 6 130° 23' 08.7 E 073° 11' 07.7 N WP 7 129° 32' 38.1 E 073° 31' 25.6 N WP 8 128° 52' 45.5 E 073° 45' 04.0 N WP 9 128° 43' 40.0 E 073° 38' 34.6 N WP 10 128° 52' 16.7 E 071° 37' 29.1 N
			15:10				End			

Station		Date	Time (Tiksi)	Latitude (°N)	Longitude (°E)	Water depth (m)	Activity	Ice thickness	Weather	Comments
TI 12 09		17.04.12	14:10	73°38'34,2	128°43'37,3	17,7	Begin	17,7	-10°C, snowfall	CAMP NORTH
	-1						Recovery mooring CAMP NORTH			
	-2						Oceanography			
	-3						Hydrochemistry			
	-4						Biology			
			16:15				End			
TI 12 10		19.04.12	14:10	71°41'51	130°09'12,8	11	Begin		-16°C, sunny	CAMP SOUTH
	-1						Recovery “MISHKA II”			
	-2						Oceanography			
	-3						Hydrochemistry			
	-4						Biology			
			19:30				End			
TI 12 11		20.04.12					EM-Bird, photo and temperature profiling		-15°C, sunny	Sea-ice-thickness survey: N off Lena Delta Long distance flight (300km)
			10:40				Start Tiksi airport			WP 1 127°07'21'' E 073°42'27'' N
	-1		12:57	73°42'27''	127°07'21''		Start EM-Bird			WP 2 126°22'23'' E 074°47'32'' N
			15:28	73°31'27''	129°32'15''		End EM-Bird			WP 3 129°32'15'' E 073°31'27'' N
			18:00				End Tiksi airport			

Press releases

Informationsdienst Wissenschaft

Pressemitteilung

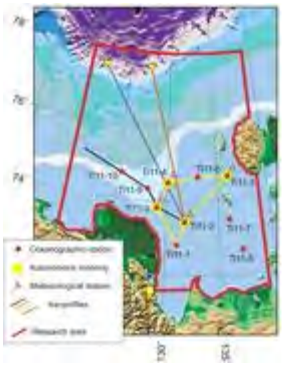
Jubiläums-Expedition ins arktische Eis

Andreas Villwock Kommunikation und Medien
GEOMAR | Helmholtz-Zentrum für Ozeanforschung Kiel

21.03.2012 09:55

- TRANSDRIFT XX untersucht Meereis und Ökosystem in der sibirischen Laptev-See -

Runder Geburtstag für die russisch-deutsche Arktisforschung: Die 20. binationale TRANSDRIFT Expedition startet diese Woche in die sibirische Laptev-See. Auf dem Programm stehen Untersuchungen des Meereises, des Klimas und der Biologie in dem arktischen Randmeer.



Arbeitsgebiet der Expedition Transdrift XX
Grafik: GEOMAR

Experten betrachten das Ausmaß und die Geschwindigkeit des Klimawandels in der Arktis mit Besorgnis. Die Eisfläche des Nordpolarmeers ist in den Sommermonaten drastisch geschrumpft und das Eisvolumen hat in den vergangenen 30 Jahren sogar um 75 Prozent abgenommen. Das Meereis ist brüchig und es gibt viele offene Wasserflächen. Besonders einschneidend sind die Veränderungen in der sibirischen Arktis, wo ein Großteil des Meereises für die Arktis produziert wird. Es gibt immer weniger Packeis, das die Sommer übersteht und so über die Jahre wachsen kann. Die mittlere Geschwindigkeit mit der das Eis driftet, hat sich in den vergangenen Jahren verdoppelt.

„Die Klimaänderung in diesen Regionen ist mittlerweile mit bloßen Augen zu beobachten“, sagt Dr. Heidemarie Kassens vom GEOMAR | Helmholtz-Zentrum für Ozeanforschung Kiel. Sie beschäftigt sich seit 20 Jahren mit Klimaschwankungen der Polarregion und hat seitdem zahlreiche Expeditionen in den hohen Norden durchgeführt. Jetzt reist sie erneut als Expeditionsleiterin in die sibirische Hafenstadt Tiksi, Ausgangspunkt für die 20. deutsch-russische TRANSDRIFT-Expedition in die Laptev-See

Wie schon bei früheren Winter-Expeditionen in die Laptev-See gelangen die Wissenschaftler mit Hilfe von Hubschraubern auf das Festeis.
Foto: H. Kassens, GEOMAR

Während der kommenden vier Wochen werden die Wissenschaftler östlich und nördlich des Lena-Deltas auf dem Festeis der Laptev-See Camps einrichten, von denen aus sie mit verschiedenen Methoden die Dicke, die Struktur und die Stabilität des Eises untersuchen. „Noch herrscht in der Arktis Winter, die Laptev-See ist also fest zugefroren. Um aufs Eis zu gelangen, nutzen wir Hubschrauber, die uns jeweils von Tiksi zu unseren Forschungscamps bringen“, erklärt Dr. Kassens. Außerdem nutzen die Wissenschaftler die Hubschrauber als Forschungsplattform: Mit speziellen am Alfred-Wegener-Institut für Polar- und Meeresforschung Bremerhaven (AWI) entwickelten elektromagnetischen Messgeräten, die über das Eis geflogen werden, kann großflächig die Eisdicke bestimmt werden. Biologen werden studieren in wie weit das Ökosystem bereits von den veränderten Umweltbedingungen betroffen ist.

Außerdem bauen Wissenschaftler der Universität Trier automatische Wetterstationen auf, die kontinuierlich atmosphärische Parameter messen. Echte Handarbeit ist auch gefragt, wenn die For-scher und Techniker das bis zu zwei Meter dicke Eis durchbohren, um Verankerungen auf den Meeresboden der Laptev-See herabzulassen. An den Verankerungen sind Geräte befestigt, die Daten wie Wassertemperaturen, Strömungsgeschwindigkeiten und andere Eigenschaften des Meerwassers unter dem Eis messen.

Das Untersuchungsgebiet ist für das Verständnis der gesamten Arktis von Bedeutung, weil am nördlichen Rand der Laptev-See zwischen Festeis und Packeis sogenannte Polynjas verlaufen. Das sind auch im Winter offene Wasserflächen, in denen große Teile des Meereises für den arktischen Ozean gebildet werden. „Polynjas reagieren sehr sensibel und schnell auf Veränderungen in der ozeanischen und atmosphärischen Zirkulation und können somit als Modell dafür herangezogen werden, wie sich letztere auf die Arktis auswirken werden“, erklärt Dr. Kassens. Schon in den vergangenen Jahren konnten die Wissenschaftler bei ihren Untersuchungen deutliche Ände-rungen der Wassereigenschaften, der Eisbildung, aber auch der Artenzusammensetzung unter dem Eis feststellen. „Umso wichtiger ist, dass wir die Beobachtungen in Zukunft fortsetzen, um langfristige Aussagen treffen zu können“ betont Dr. Kassens.

Das Forscher-Team besteht aus 18 Wissenschaftlern des Alfred-Wegener-Instituts für Polar- und Meeresforschung Bremerhaven (AWI), des staatlichen Instituts für Arktis- und Antarktis-Forschung Russlands (AARI), des GEOMAR | Helmholtz-Zentrums für Ozeanforschung Kiel, des Lena Delta Naturreservats, der staatlichen Lomonossow-Universität Moskau, der Universität St. Petersburg und der Universität Trier.

Die Expedition ist Teil des Deutsch-Russischen Projekts „System-Laptev-See“, das vom Bundesministerium für Bildung und Forschung (BMBF), vom Russischen Ministerium für Bildung und Forschung, sowie vom AARI, vom AWI, der Universität Trier und vom GEOMAR finanziert wird.

Expedition auf einen Blick:
TRANSDRIFT XX
Zeit: 19.03. bis 23.04.2012
Ort: Tiksi, Laptev-See (Nordostibirien, Russland)
Leiterin: Dr. Heidemarie Kassens (GEOMAR)
Thema: Auswirkungen des Klimawandels in arktischen Schelfmeeren

Weitere Informationen:

http://www.geomar.de/434 Das Projekt „Eurasische Schelfmeere im Umbruch - Ozeanische Fronten und Polynjasysteme in der Laptevsee

URL dieser Pressemitteilung: http://idw-online.de/pages/de/news468918

Merkmale dieser Pressemitteilung:
Journalisten, Wissenschaftler, jedermann
Geowissenschaften, Meer / Klima, Umwelt / Ökologie
überregional

Forschungsprojekte, Kooperationen
Deutsch

Pressemitteilung

GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

21/2012

Jubiläums-Expedition ins arktische Eis
TRANSDRIFT XX untersucht Meereis und Ökosystem in der sibirischen Laptev-See

***21.03.2012/Kiel*. Runder Geburtstag für die russisch-deutsche Arktisforschung: Die 20. binationale TRANSDRIFT Expedition startet diese Woche in die sibirische Laptev-See. Auf dem Programm stehen Untersuchungen des Meereises, des Klimas und der Biologie in dem arktischen Randmeer.**

Experten betrachten das Ausmaß und die Geschwindigkeit des Klimawandels in der Arktis mit Besorgnis. Die Eisfläche des Nordpolarmeers ist in den Sommermonaten drastisch geschrumpft und das Eisvolumen hat in den vergangenen 30 Jahren sogar um 75 Prozent abgenommen. Das Meereis ist brüchig und es gibt viele offene Wasserflächen. Besonders einschneidend sind die Veränderungen in der sibirischen Arktis, wo ein Großteil des Meereises für die Arktis produziert wird. Es gibt immer weniger Packeis, das die Sommer übersteht und so über die Jahre wachsen kann. Die mittlere Geschwindigkeit mit der das Eis driftet, hat sich in den vergangenen Jahren verdoppelt.

„Die Klimaänderung in diesen Regionen ist mittlerweile mit bloßen Augen zu beobachten“, sagt Dr. Heidemarie Kassens vom GEOMAR | Helmholtz-Zentrum für Ozeanforschung Kiel. Sie beschäftigt sich seit 20 Jahren mit Klimaschwankungen der Polarregion und hat seitdem zahlreiche Expeditionen in den hohen Norden durchgeführt. Jetzt reist sie erneut als Expeditionsleiterin in die sibirische Hafenstadt Tiksi, Ausgangspunkt für die 20. deutsch-russische TRANSDRIFT-Expedition in die Laptev-See

Während der kommenden vier Wochen werden die Wissenschaftler östlich und nördlich des Lena-Deltas auf dem Festeis der Laptev-See Camps einrichten, von denen aus sie mit verschiedenen Methoden die Dicke, die Struktur und die Stabilität des Eises untersuchen. „Noch herrscht in der Arktis Winter, die Laptev-See ist also fest zugefroren. Um aufs Eis zu gelangen, nutzen wir Hubschrauber, die uns jeweils von Tiksi zu unseren Forschungscamps bringen“, erklärt Dr. Kassens. Außerdem nutzen die Wissenschaftler die Hubschrauber als Forschungsplattform: Mit speziellen am Alfred-Wegener-Institut für Polar- und Meeresforschung Bremerhaven (AWI) entwickelten elektromagnetischen Messgeräten, die über das Eis geflogen werden, kann großflächig die Eisdicke bestimmt werden. Biologen werden studieren in wie weit das Ökosystem bereits von den veränderten Umweltbedingungen betroffen ist.

Außerdem bauen Wissenschaftler der Universität Trier automatische Wetterstationen auf, die kontinuierlich atmosphärische Parameter messen. Echte Handarbeit ist auch gefragt, wenn die Forscher und Techniker das bis zu zwei Meter dicke Eis durchbohren, um Verankerungen auf den Meeresboden der Laptev-See herabzulassen. An den Verankerungen sind Geräte befestigt, die Daten wie Wassertemperaturen, Strömungsgeschwindigkeiten und andere Eigenschaften des Meerwassers unter dem Eis messen.

Das Untersuchungsgebiet ist für das Verständnis der gesamten Arktis von Bedeutung, weil am nördlichen Rand der Laptev-See zwischen Festeis und Packeis sogenannte Polynjas verlaufen. Das sind auch im Winter offene Wasserflächen, in denen große Teile des Meereises für den arktischen Ozean gebildet werden. „Polynjas reagieren sehr sensibel und schnell auf Veränderungen in der ozeanischen und atmosphärischen Zirkulation und können somit als Modell dafür herangezogen werden, wie sich letztere auf die Arktis auswirken werden“, erklärt Dr. Kassens. Schon in den vergangenen Jahren konnten die Wissenschaftler bei ihren Untersuchungen deutliche Ände-rungen der Wassereigenschaften, der Eisbildung, aber auch der Artenzusammensetzung unter dem Eis feststellen. „Umso wichtiger ist, dass wir die Beobachtungen in Zukunft fortsetzen, um langfristige Aussagen treffen zu können“ betont Dr. Kassens.

Das Forscher-Team besteht aus 18 Wissenschaftlern des Alfred-Wegener-Instituts für Polar- und Meeresforschung Bremerhaven (AWI), des staatlichen Instituts für Arktis- und Antarktis-Forschung Russlands (AARI), des GEOMAR | Helmholtz-Zentrums für Ozeanforschung Kiel, des Lena Delta Naturreservats, der staatlichen Lomonossow-Universität Moskau, der Universität St. Petersburg und der Universität Trier.

Die Expedition ist Teil des Deutsch-Russischen Projekts „System-Laptev-See“, das vom Bundesministerium für Bildung und Forschung (BMBF), vom Russischen Ministerium für Bildung und Forschung, sowie vom AARI, vom AWI, der Universität Trier und vom GEOMAR finanziert wird.

Expedition auf einen Blick:
TRANSDRIFT XX
Zeit: 19.03. bis 23.04.2012
Ort: Tiksi, Laptev-See (Nordostibirien, Russland)
Leiterin: Dr. Heidemarie Kassens (GEOMAR)
Thema: Auswirkungen des Klimawandels in arktischen Schelfmeeren

Links:
www.geomar.de/434 Das Projekt „Eurasische Schelfmeere im Umbruch - Ozeanische Fronten und Polynjasysteme in der Laptevsee“

Bildmaterial:
Unter www.geomar.de/ steht Bildmaterial zum Download bereit.

Ansprechpartner:
Dr. Heidemarie Kassens (GEOMAR, FB1-Paläoozeanographie), hkassens@geomar.de
Jan Steffen (GEOMAR, Kommunikation & Medien), Tel.: 0431 600-2811, jsteffen@geomar.de

Pressemitteilung

32/2012

Diplomaten besuchen Wissenschaftler im arktischen Eis
Delegation der Deutschen Botschaft in Moskau begleitet bilaterale Forschung in Ostsibirien

***19.04.2012/Kiel/Moskau*. Vier Tage lang haben der Ständige Vertreter des Botschafters der Bundesrepublik Deutschland in Russland, Dr. Georg Birgelen, und der Leiter des Referats für Wissenschaft und Bildung der Deutschen Botschaft, Karsten Heinz, ein deutsch-russisches Wissenschaftlerteam in der sibirischen Laptewsee besucht. Die Delegation informierte sich über Forschungen zum Klimawandel in der Arktis und die deutsch-russische Zusammenarbeit in der Polar- und Meeresforschung.**

Während in Deutschland die Temperaturen langsam den Frühling ankündigen, herrschen in der sibirischen Laptewsee noch bitterkalte Minusgrade. Auf dem fest zugefrorenen Randmeer des arktischen Ozeans arbeiten seit Mitte März 19 Wissenschaftler aus Russland und Deutschland gemeinsam daran, mehr über die Struktur, die Stabilität und die langfristige Entwicklung des arktischen Meereises sowie die Auswirkungen des Klimawandels auf diese sensible Region zu erfahren.

In dieser Woche erhielten sie Besuch von hochrangigen Diplomaten aus Moskau: Der Ständige Vertreter des Botschafters der Bundesrepublik Deutschland, Dr. Georg Birgelen, und der Leiter des Referats für Wissenschaft und Bildung der Botschaft, Karsten Heinz, waren am Montag zum Hauptquartier der Forscher in der sibirischen Hafenstadt Tiksi gereist. Vier Tage lang verschafften sich die Gäste einen Eindruck von der Arbeit der Wissenschaftler, vom Stand der Arktisforschung und von der engen Kooperation zwischen deutschen und russischen Forschern. „Ich bin beeindruckt von der guten Zusammenarbeit unter den schwierigen klimatischen Bedingungen der Arktis, aber auch davon, wie sehr die Wissenschaftler beider Nationen in das lokale Leben in Tiksi integriert sind. Hier wird nicht nur für die Zukunft geforscht, sondern auch ganz praktisch Völkerverständigung betrieben", sagte Dr. Birgelen kurz vor der Abreise am heutigen Donnerstag.

Der Hauptteil der Arbeit spielt sich für die Forscher nicht in Tiksi, sondern in einem Radius von mehreren hundert Kilometern vor der Hafenstadt auf dem Festeis der Laptewsee ab. Dort haben sie in den vergangenen Wochen mehrere Forschungseiscamps aufgebaut, in denen sie physikalische und biologische Parameter des Eises, des Meerwassers darunter sowie der Atmosphäre darüber messen. Schon am ersten Tag nach ihrer Ankunft in Tiksi flogen auch die Gäste von der Deutschen Botschaft mit den Wissenschaftlern auf das Eis, wo sie auch in die Stationsarbeiten einbezogen wurden. Zurück auf dem Festland standen Besuche des Arktischen Gymnasiums und des Lena-Delta-Reservats in Tiksi sowie der ewenkischen Siedlung Bykow im Lenadelta auf dem Programm.

Das Meer vor der Hafenstadt Tiski ist für die Wissenschaftler besonders interessant, weil am nördlichen Rand der Laptewsee zwischen Fest- und Packeis sogenannte Polynjas, auch im Winter offene Wasserflächen, die für die Meereisbildung für den Arktischen Ozean von entscheidender Bedeutung sind, verlaufen. „Polynjas reagieren äußerst empfindlich auf Veränderungen in der ozeanischen und atmosphärischen Zirkulation. Wir können sie also als Modell dafür heranziehen, wie sich diese Veränderungen auf die gesamte Arktis auswirken werden“, erklärt die Expeditionsleiterin Dr. Heidemarie Kassens vom GEOMAR | Helmholtz-Zentrum für Ozeanforschung Kiel.

An der Expedition TRANSDRIFT XX sind Wissenschaftler des Alfred-Wegener-Instituts für Polar- und Meeresforschung Bremerhaven (AWI), des staatlichen Instituts für Arktis- und Antarktisforschung Russlands (AARI), des GEOMAR aus Kiel, des Lena-Delta-Naturreservats, der Staatlichen Lomonossow-Universität Moskau, der Staatlichen Universität Sankt Petersburg und der Universität Trier beteiligt. Sie ist Teil des deutsch-russischen Projekts „System Laptewsee“, das vom Bundesministerium für Bildung und Forschung, vom Russischen Ministerium für Bildung und Forschung, sowie vom AARI, vom AWI, der Universität Trier und vom GEOMAR finanziert wird. „Hier in der Laptewsee hat die bilaterale Zusammenarbeit von deutschen und russischen Wissenschaftlern eine lange Tradition. Das Deutsch-Russische Jahr der Bildung, Wissenschaft und Innovation 2011/2012 war deshalb eine gute Gelegenheit, die Jubiläumsexpedition TRANSDRIFT XX zu besuchen und damit sowohl das Engagement und die hervorragenden gemeinsamen Forschungsergebnisse deutscher und russischer Wissenschaftler als auch die gute Zusammenarbeit mit den russischen Behörden bei der Durchführung der Expedition zu würdigen“, betonte Dr. Birgelen.

Links:
www.geomar.de/434 Das Projekt „Eurasische Schelfmeere im Umbruch - Ozeanische Fronten und Polynjasysteme in der Laptevsee“
www.moskau.diplo.de Die Deutsche Botschaft Moskau im Internet

Bildmaterial:
Unter www.geomar.de/ steht Bildmaterial zum Download bereit.

Ansprechpartner:
Dr. Heidemarie Kassens (GEOMAR, FB1-Paläoozeanographie), hkassens@geomar.de
Jan Steffen (GEOMAR, Kommunikation & Medien), Tel.: 0431 600-2811, jsteffen@geomar.de

Пресс-релиз

GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

ПОСОЛЬСТВО
ФЕДЕРАТИВНОЙ РЕСПУБЛИКИ ГЕРМАНИЯ
МОСКВА

Российско-Германский год образования, науки и инноваций 2011/12
Deutsch-Russisches Jahr der Bildung, Wissenschaft und Innovation 2011/12

32/2012

Дипломаты навестили ученых в арктических льдах
Делегация Посольства Германии в Москве сопровождает двусторонние научно-исследовательские работы в Восточной Сибири

***19.04.2012/Киль/Москва*. В течение четырех дней Постоянный заместитель Посла Федеративной Республики Германия в России Георг Биргелен и Начальник Отдела науки и образования Посольства Германии Карстен Хайнц были в гостях у германо-российского научного коллектива в сибирском море Лаптевых. Делегация получила информацию о научных исследованиях изменения климата в Арктике и германо-российском сотрудничестве в области полярных и морских исследований.**

В то время, когда в Германии температуры медленно возвещают весну, в сибирском море Лаптевых еще господствуют ледяные минусовые температуры. На льду накрепко замерзшего окраинного моря Северного Ледовитого океана с середины марта 19 ученых из России и Германии совместно работают над тем, чтобы узнать больше о структуре, стабильности и долгосрочном развитии арктических морских льдов, а также о влиянии изменения климата на этот чувствительный регион.

На этой неделе у них в гостях побывали высокопоставленные дипломаты из Москвы: Постоянный заместитель Посла Федеративной Республики Германия Георг Биргелен и Начальник Отдела науки и образования Посольства Карстен Хайнц в понедельник прибыли в штаб-квартиру исследователей в сибирском портовом городе Тикси. В течение четырех дней гости получали впечатления о работе ученых, о состоянии арктических исследований и о тесном сотрудничестве между германскими и российскими исследователями. «Я впечатлен хорошим сотрудничеством в тяжелых климатических условиях Арктики, но также и тем, насколько сильно интегрированы ученые двух стран в локальную жизнь в Тикси. Здесь не только проводятся научные исследования ради будущего, но и весьма практично осуществляется процесс взаимопонимания между народами», - сказал господин Биргелен незадолго до отъезда сегодня, то есть в четверг.

Однако главная часть работы разворачивается для исследователей не в Тикси, а в радиусе нескольких сотен километров севернее портового города на ледовом припае моря Лаптевых. Там они за прошедшие недели построили несколько научно-исследовательских ледовых станций, в которых они выполняют измерения физических и биологических параметров льда, морской воды под ним, а также атмосферы над ним. Уже в первый день по прибытии в Тикси гости из Посольства Германии тоже полетели вместе с учеными на лед, где их привлекли и к работам на станции. По возвращении на сушу программа включала в себя визиты в Арктическую гимназию и в Усть-Ленский заповедник в Тикси, а также в эвенкийский поселок Быков в дельте Лены.

Море перед портовым городом Тикси особенно интересно для ученых, так как на северной окраине моря Лаптевых между припаем и паковым льдом расположены так называемые «полыньи» - водные пространства, открытые и зимой, имеющие решающее значение для образования морских льдов Северного ледовитого океана. «Полыньи исключительно чувствительно реагируют на изменение океанической и атмосферной циркуляции. Таким образом, мы можем привлечь их в качестве модели того, как эти изменения скажутся на всей Арктике», - заявляет руководитель экспедиции госпожа Хайдемари Кассенс из Центра океанических исследований им. Гельмгольца (GEOMAR), г. Киль.

В экспедиции TRANSDRIFT XX участвуют ученые из Института полярных и морских исследований им. Альфреда Вегенера, г. Бремерхафен (AWI), российского Арктического и антарктического научно-исследовательского института (ААНИИ), GEOMAR из Киля, Усть-Ленского заповедника, Московского государственного университета им. Ломоносова, Санкт-Петербургского государственного университета и Трирского университета. Она является частью германо-российского проекта «Система моря Лаптевых», который финансируется Федеральным министерством образования и научных исследований Федеративной Республики Германия, Министерством образования и науки Российской Федерации, а также ААНИИ, AWI, Трирским университетом и GEOMAR. «Здесь, в море Лаптевых двустороннее сотрудничество германских и российских ученых опирается на многолетние традиции. Поэтому германо-российский Год образования, науки и инноваций 2011/2012 стал хорошим поводом для того, чтобы посетить юбилейную экспедицию TRANSDRIFT XX и тем самым оценить по достоинству как активную работу и выдающиеся совместные результаты научных исследований германских и российских ученых, так и хорошее сотрудничество с российскими властями при проведении экспедиции», - подчеркнул господин Биргелен.

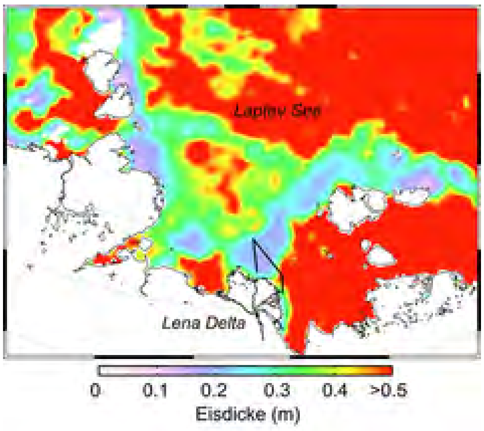
Ссылки:
www.geomar.de/434 Проект «Евразийские шельфовые моря в переломный период – океанические фронты и системы полыней в море Лаптевых»
www.moskau.diplo.de Интернет-сайт Посольства Германии в Москве

Иллюстрации:
На сайте www.geomar.de/ можно скачать иллюстративные материалы.

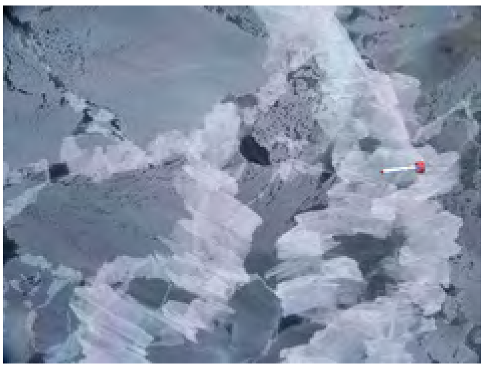
Контактные лица:
Госпожа Хайдемари Кассенс (GEOMAR, FB1-палеоокеанография), hkassens@geomar.de
Ян Штеффен (GEOMAR, связи с прессой и общественностью), тел.: +49-431 600-2811, jsteffen@geomar.de

8. Juni 2012: **Nordost-Passage bald wieder eisfrei? Wintermessungen zeigen dünnes Meereis in der Laptewsee, das auf eine frühe und großflächige Sommerschmelze hindeutet**

Bremerhaven, 8. Juni 2012, **Die Nordost-Passage, der Seeweg entlang der Nordküste Russlands, wird in diesem Sommer vermutlich wieder frühzeitig eisfrei sein. Diese Vorhersage treffen Meereisphysiker des Alfred-Wegener-Institutes für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft nach Messflügen über der Laptewsee, einem Randmeer des Arktischen Ozeans. Es gilt unter Experten als „Eismotor der Arktis“. Zum Ende des vergangenen Winters stießen die Forscher hier allerdings auf große Eisflächen, deren Dicke maximal 50 Zentimeter betrug und kaum ausreichen wird, um der Sommersonne für eine lange Zeit zu trotzen.**



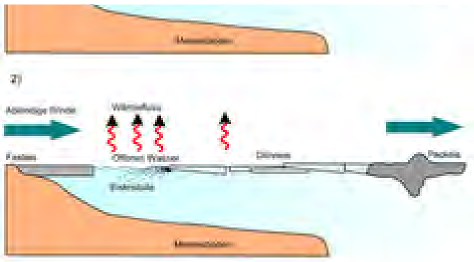
„Diese Ergebnisse haben uns sehr überrascht“, sagt Expeditionsteilnehmer Dr. Thomas Krumpen. Bei vorhergehenden Messungen im Winter 2007/2008 sei das Eis im selben Gebiet bis zu einen Meter dicker gewesen. Verantwortlich für diese deutlichen Unterschiede ist seiner Meinung nach in erster Linie der Wind „Er verhält sich von Jahr zu Jahr anders. Weht der Wind wie im vergangenen Winter vom Festland auf das Meer hinaus, drückt er dabei das Packeis aus der Laptewsee Richtung Norden. Auf diese Weise entstehen vor der Küste offene Wasserflächen, die sogenannten Polynien. Ihr Oberflächenwasser kühlt bei einer Lufttemperatur von minus 40 Grad Celsius natürlich sehr schnell aus. Neues dünnes Eis bildet sich und wird vom Wind sofort wieder abtransportiert. Aufgrund dieses Kreislaufes entstehen dann auf der Laptewsee je nach Windstärke und -kontinuität verschieden große Dünneisflächen“, erklärt Thomas Krumpen. (siehe Infografiken)
Wie groß diese Flächen jedoch tatsächlich werden können, war dem Expeditionsteam bis zu seinen Messflügen im März und April dieses Jahres nicht bewusst. Stellenweise flogen die Forscher mit ihrem Helikopter rund 400 Kilometer weit über ausschließlich dünnes Eis hinweg. An einem Kabel unter dem Hubschrauber hing dabei „EM-Bird“, der torpedoförmige elektromagnetische Eisdickensensor des Alfred-Wegener-Institutes. Er erfasste stetig die Dicke der Eisschollen. „Wir haben jetzt einen einmaligen Datensatz, mit dem wir vor allem die Messungen des Erderkundungssatelliten SMOS überprüfen wollen “, sagt Thomas Krumpen.



Hinter der Abkürzung SMOS (Soil Moisture and Ocean Salinity) steckt eigentlich eine Satellitenmission zur Fernerkundung der Bodenfeuchte des Festlandes und des Salzgehaltes der Meere. Der Satellit der Europäischen Weltraumagentur (ESA) kann jedoch auch für die Vermessung des arktischen Meereises eingesetzt werden. „Mit ihm lassen sich vor allem solche dünnen Eisflächen, wie wir sie gesehen haben, aus dem All erfassen“, so Thomas Krumpen.
Die SMOS-Satellitenmessungen von März und April dieses Jahres bestätigen, dass die vom Expeditionsteam entdeckten Dünneisflächen kein örtlich begrenztes Phänomen waren: „Ein großer Teil der Nordost-Passage war am Ende des Winters durch überraschend dünnes Eis geprägt“, sagt Thomas Krumpen.
Die neuen Erkenntnisse der erfolgreichen Winterexpedition geben den Wissenschaftlern zu denken: „Diese riesigen, neu entstandenen Dünneisflächen werden die ersten sein, die im Zuge der Sommerschmelze verschwinden werden. Und wenn das dünne Eis so schnell schmilzt, wie wir vermuten, wird die Laptewsee und damit ein Teil der Nordost-Passage in diesem Sommer vergleichsweise früh eisfrei sein“, sagt der Meereisphysiker.

In der Vergangenheit war die Laptewsee stets von Oktober bis zum Ende des darauffolgenden Juli mit Meereis bedeckt und für Schiffe maximal zwei Sommermonate lang befahrbar. Im Jahr 2011 aber war das Eis bereits in der dritten Juliwoche so weit zurückgewichen, dass im Laufe des Sommers erstmals

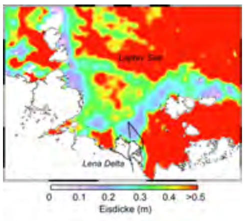
33 Schiffe die Reise durch die arktischen Gewässer Russlands meisterten. Im Jahr zuvor waren es zehn gewesen. Die Nordost-Passage gilt für Reedereien als zeit- und treibstoffsparende Alternative zur herkömmlichen Europa-Asien-Route. Ist die Wegstrecke von Rotterdam in das japanische Yokohama über die Nordost-Passage doch etwa 3800 Seemeilen kürzer als die Verbindung über den Suezkanal und den Indischen Ozean.



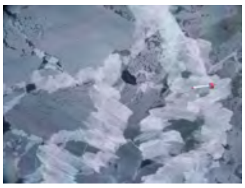
Hinweise für Redaktionen:
Die Messkampagne fand statt im Rahmen des vom Bundesministerium für Bildung und Forschung geförderten deutsch-russischen Verbundvorhabens "System Laptewsee".
Ihre Ansprechpartner am Alfred-Wegener-Institut sind Meereisphysiker Dr. Thomas Krumpen (Tel.: 0471 4831-1753; E-Mail: Thomas.Krumpen(at)awi.de) sowie in in der Abteilung Kommunikation und Medien des Alfred-Wegener-Institutes Sina Löschke (Tel.: 0471 4831-2008; E-Mail: Sina.Loeschke(at)awi.de).
Allgemeine Informationen zum SMOS-Satelliten finden Sie auf der ESA-Website unter http://www.esa.int/esaCP/SEMB4L4AD1G_Germany_0.html und speziell zu den Meereisdickenmessungen des Satelliten unter http://www.esa.int/esaLP/SEM361BX9WG_index_0.html

Das Alfred-Wegener-Institut forscht in der Arktis, Antarktis und den Ozeanen der mittleren und hohen Breiten. Es koordiniert die Polarforschung in Deutschland und stellt wichtige Infrastruktur wie den Forschungseisbrecher Polarstern und Stationen in der Arktis und Antarktis für die internationale Wissenschaft zur Verfügung. Das Alfred-Wegener-Institut ist eines der 18 Forschungszentren der Helmholtz-Gemeinschaft, der größten Wissenschaftsorganisation Deutschlands.

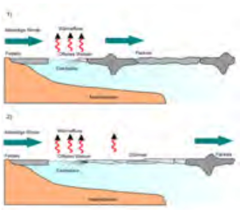
Druckbare Bilder



SMOS-Daten
Eisdicken in der Laptewsee am Ende des vergangenen Winters (20. April, 2012). Die Meereisdicken wurden mit dem SMOS (Soil Moisture Ocean Saliniy) Satelliten ermittelt, der Eisdicken bis zu 50 Zentimeter auflösen kann. Die schwarze Linie zeigt die Flugroute der AWI-Wissenschaftler. SMOS-Daten: Lars Kaleschke, KlimaCampus, Universität Hamburg
web print



Der EM-Bird über dünnem Eis in der Laptewsee
Dieses Foto wurde von einer Luftbildkamera gemacht, die im Hubschrauber vorab installiert wurde. Sie zeigt den EM-Bird, der in 15 Metern Höhe über einer zusammengeschobenen Dünneisfläche hängt, die etwa zehn Zentimeter dick ist. Foto: Thomas Krumpen, Alfred-Wegener-Institut
web print



Infografik zur Meereisbildung in einer Polynia
Schematische Zeichnung einer Polynja in der Laptewsee: Das frei treibende Packeis wird durch ablandige Winde vom am Land verankerten Festeis weggetrieben. So entstehen neue offene Wasserflächen in denen bei extrem geringen Temperaturen Eiskristalle entstehen. Die Eiskristalle bilden neue Dünneisflächen, die später in den zentralen Arktischen Ozean exportiert werden. Grafik: Thomas Krumpen, Alfred-Wegener-Institut
web print

Der EM-Bird auf dem Festeis
Der EM-Bird der Meereisgruppe des Alfred-Wegener-Institutes vor einem Helikopter (MI-8) auf russischem Festeis. Der EM-Bird ist ein Sensor zur Bestimmung der Dicke des Meereises mit Helikoptern und Flugzeugen. Basierend auf dem aerogeophysikalischen elektromagnetischen (EM) Induktionsverfahren, wird die Dicke des Meereises bestimmt durch die Untersuchung der elektrischen Leitfähigkeit des Untergrundes. Foto: Jens Hölemann, Alfred-Wegener-Institut
web print

Daily reports

Daily reports of the expedition TRANSDRIFT XX

Tiksi, 23.3.2012, -30°C, sonnig

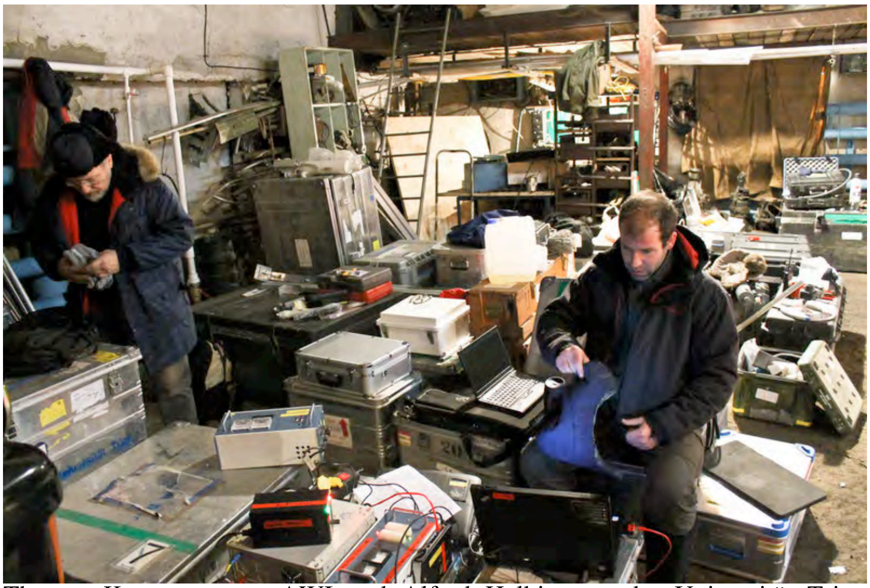
Gut in der sibirischen Arktis angekommen

Nach fast zweitägiger Anreise sind wir am Dienstag, den 21. März, mit nur 15 Minuten Verspätung in Tiksi angekommen. Wir sind seit Mittwoch dabei, unsere Geräte auszupacken, aufzubauen und die Labors einzurichten. Montag planen wir den ersten Hubschrauberflug in Richtung Laptewsee-Polynja.

Die Expeditionsteilnehmer

Immer dabei ein kleines Hunderudel. Die Hunde bewachen auch nachts unsere Geräte in der Gerätehalle des Lena-Delta-Reservats.

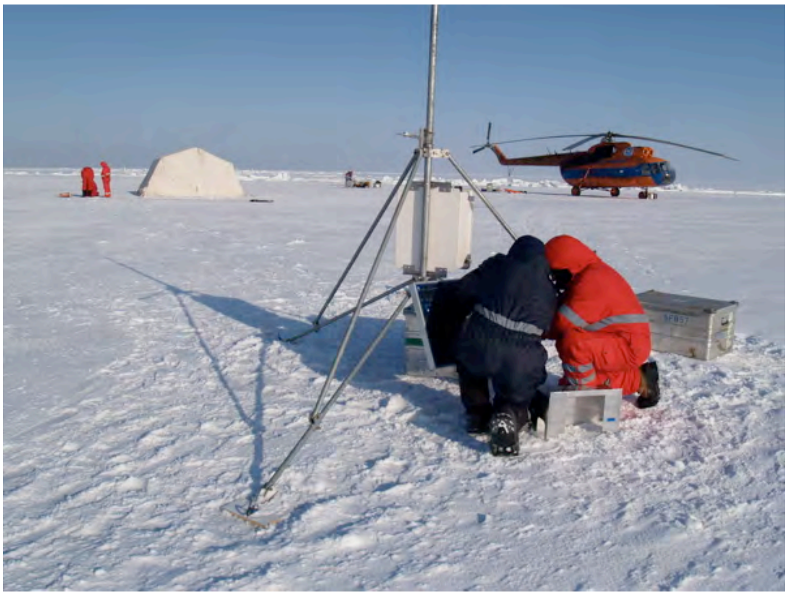
Zum dritten Mal in Tiksi ist der EM-Bird des AWI. Pünktlich und ohne Schäden ist das Gerät heute eingetroffen. Der so genannte Bird ist bereits einsatzbereit, und die ersten Eisdickenmessungen sollen nächste Woche vom Hubschrauber aus durchgeführt werden.



Thomas Krumpen vom AWI und Alfred Helbig von der Universität Trier bereiten ihre Geräte für den ersten Einsatz auf dem Eis vor. Platz genug steht dieses Mal dafür in der geheizten Gerätehalle des Lena-Delta-Reservats zur Verfügung, die wir seit Beginn der Expedition in Beschlag genommen haben.

Tiksi, 31.3.2012

Erste Forschungsarbeiten in zwei Eis-Camps: Minus 24°C und Wind mit 12 m/s aus Ost ergeben gefühlte minus 39°C. Diese Kälte macht die Stationsarbeiten auf dem Eis zu einem Wettlauf gegen die Zeit. Besonders schwer hatten es Alfred Helbig und Daniel Kramer (Universität Trier) beim Aufbau der ersten meteorologischen Messstation „Mishka I“. Auch die Eisphysiker Igor Sheikin und Leonid Panov (Institut für Arktis- und Antarktisforschung, Sankt Petersburg) mussten bis zu 6 Stunden ungeschützt auf dem Eis arbeiten. Sie wollen die Stabilität des Festeises bestimmen und dazu müssen sie Löcher in das Eis bohren, 10-Meter-lange Gräben aussägen und viele komplizierte Messungen durchführen. Besser hatten es die Ozeanographen, Biologen und Meereschemiker, die im „beheizten“ Zelt arbeiten konnten. Aber auch hier dampften die Köpfe und die feinmaschigen Netze der Biologen waren schnell steif gefroren.



Auf dem Festeis der östlichen Laptewsee haben wir drei Eis-Camps (Camp North, Central Camp, Camp South) eingerichtet. Hier werden wir in den nächsten Wochen meteorologische, ozeanographische, meereschemische, eisphysikalische, biologische und sedimentologische Messungen durchführen. Dazu haben wir verschiedene Messgeräte aufgebaut. Die Eis-Camps werden im Laufe der Expedition mehrfach angeflogen. Ziel ist es, Auswirkungen des Klimawandels in der sibirischen Arktis zu beschreiben.

Erkältungswelle in Tiksi: Kindergärten, Schulen und die Musikschule Tiksi wurden in dieser Woche wegen einer Erkältungswelle geschlossen. Einige der Expeditionsteilnehmer hat es auch schon erwischt. Gut, dass Wochenende ist und die Ruhe und viele Zitronen anscheinend ihre Wirkung zeigen, so dass am Montag hoffentlich alle wieder gesund sind.

Ein Großteil der Forschungsarbeiten auf dem Festeis wird in einem fast 20-m^2-großen und beheizten Klappzelt durchgeführt. Jens Hölemann (Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven) und Torben Klagge (GEOMAR | Helmholtz-Institut für Ozeanforschung, Kiel) führen ozeanographische und meereschemische Messungen in der Wassersäule durch. Dazu haben sie ein Loch (Durchmesser 20 cm) in das 130-cm-dicke Festeis gebohrt. Durch dieses Loch werden die Messgeräte bis zum Meeresboden in 23 m Wassertiefe gefiert.

Mein erstes Eiscamp am 26.3.2012

Nach den ersten zwei Helikopterflügen zu unseren Stationen auf dem Eis der Laptewsee sowie einem Versuch, eine dritte Station mit dem LKW auf dem Eis zu erreichen, bietet sich jetzt ein Wochenende Zeit, um alle Geräte sowie die Teilnehmer der Expedition wieder auf Vordermann zu bringen.

In diesem Tagesbericht gebe ich nun einen kleinen Einblick wie ich meine ersten beiden Tage weit draußen auf dem Eis der Laptewsee erlebt habe.

Die beiden Helikopterflüge am Montag und Dienstag fanden bei perfekten Wetterbedingungen statt und unter Polarforschern darf man sich über -38°C (gefühlte Temperatur) leider nicht beschweren.

Helikopter kurz nach der Landung – es wird entladen.

Nach etwa jeweils 1½ Stunden Flugzeit haben wir unsere Station erreicht, und es konnte mit dem Entladen des Helikopters begonnen werden. Das erste, was nun folgt, ist das Aufbauen des Zeltes, in dem die Biologen und Chemiker sowie die Ozeanographen arbeiten können. Außerdem bietet das Zelt etwas Schutz vor den eisigen Temperaturen und dem Wind, der gegen Abend an beiden Tagen auffrischte und das Arbeiten nicht erleichterte.

Die Arbeit im Allgemeinen ist auf dem Eis ziemlich anstrengend, da man so dick in Klamotten eingepackt ist, dass man sich kaum bewegen kann. Aber besonders filigrane Dinge, wie kleine Schrauben anbringen oder Kabelbinder festziehen, fallen bei diesen Temperaturen sehr schwer. Sobald ich die Handschuhe ausgezogen hatte, hatte ich nur ein paar Minuten Zeit, bis der eisige Wind meine Hände so sehr abgekühlt hatte, dass ich sie nicht mehr gespürt habe.

Bennet und Torben sind dabei, die Eisbohrer zu starten, um die ersten Eislöcher zu bohren, damit die anderen Arbeitsgruppen ihre Arbeit beginnen können.

Nach etwa sechs Stunden abwechselnden Schwitzens und Durchfrierens ist es dann geschafft – Eislöcher sind gebohrt, alle Wasserproben sind genommen, Messgeräte sind ausgesetzt und alle Eiskerne sind sicher verstaut. Nun können wir uns, nachdem alles wieder im Helikopter verstaut ist, auf den Rückweg machen.

Die Arbeitsgruppe der Eisphysik (Leonid und Igor vom Institut für Arktis- und Antarktisforschung, Sankt Petersburg) startet ihre Versuche auf dem Eis.

Im Namen des gesamten Teams
Bennet Juhls

Auch die Meereschemiker, Jens und Andrey, können nun im Zelt ihre Wasserproben nehmen.

Bennet und Torben bereiten die ozeanographischen Messgeräte vor.

Tiksi, 4.4.2012

Kurze Nächte, eisige Kälte und wolkenloser Himmel über Tiksi: Mit minus 32°C war Tiksi heute Spitzenreiter in der Arktis. Selbst am Nordpol war es wärmer. Seit Beginn der Expedition liegt Tiksi im Einflussbereich eines stabilen Hochdruckgebietes und wir hoffen sehr, das diese für die Forschungsarbeiten hervorragenden Wetterbedingungen noch ein paar Wochen anhalten werden.

Die Kälte macht uns ganz schön zu schaffen, und ohne spezielle Polarkleidung wären die Forschungsarbeiten auf dem Eis nicht durchzuführen. Daniel Kramer von der Universität Trier ist das erste Mal dabei.

Igor Sheikin und Leonid Panov vom AARI in Sankt Petersburg müssen für ihre eisphysikalischen Experimente stundenlang und ohne Schutz auf dem Eis arbeiten.

Tiksi, 11.4.2012

Darauf hatten wir gewartet! Mit dem Wind aus Süden ist das Packeis nach Norden gedriftet und zwischen dem küstennahen, stabilen Festeis und dem zurückweichenden Packeis hat sich eine Fläche mit offenem Wasser und jungem Eis – eine Polynja –gebildet. Bei -20 Grad und einem fast zweistündigen Flug über eine endlos erscheinende Eiswüste löst der Anblick der offenen Wasseroberfläche immer wieder Erstaunen und Faszination aus. Aber wieso bildet sich die Polynja gerade an dieser Stelle? Warum liegt die Kante des Festeises dieses Jahr viel weiter südlich als in den vergangenen Wintern? Wie stabil ist das Festeis wirklich? Diesen Fragen wollen wir nachgehen. Dazu haben wir an zwei Positionen ozeanographische Messgeräte im Wasser unter dem Eis verankert die die Strömung, Temperatur und den Salzgehalt über einen Zeitraum von drei Wochen aufzeichnen sollen. Eine dieser Verankerungen liegt in der Nähe der Festeiskante. Wir haben diese Position mit Sorgfalt und Vorsicht ausgewählt, denn nur ungern würden wir mit ansehen wollen, dass ein Stück der Festeiskante mitsamt unserer Verankerung abbricht, und die Geräte im Wert eines Mittelklassewagens verschwinden. Anscheinend war unsere Auswahl gut, denn unsere Geräte sind nach knapp zwei Wochen immer noch genau dort, wo wir sie verankert haben. Bis jetzt
…

Der Blick aus zirka 100 m Höhe aus dem Fenster des Hubschrauber auf die Polynja und die Kante des Festeises. Zu kalt zum Baden (-1°C), aber für die Forschung genau richtig.

Die Verankerung wird erst auf dem Eis zusammengebaut und an die aktuelle Wassertiefe angepasst. Torben und Bennet montieren einen akustischen Strömungsmesser an der Verankerungsleine. Im Vordergrund liegt der improvisierte Anker vom Schrottplatz in Tiksi.

Mehr Eis – Vier Tage campen auf dem gefrorenen Ozean

1. Planung

Die Idee, fünf Personen in einem LKW für mehrere Tage auf das Meereis zu schicken, war ganz praktischer Natur. Da die an der Expedition teilnehmenden Eisphysiker für ihre Experimente viel Zeit benötigen und entsprechend häufige Hubschrauberflüge zu viel Geld gekostet hätten, hat sich die Expeditionsleitung dazu entschlossen, ein kleines Team in einem speziell für die Arktis ausgerüsteten 12-Tonner zum "Camp South" zu schicken. Der Name rührt sehr simpel von der geographischen Position: Das südlichste der drei Camps, in denen wir arbeiten. Für diese Tour lag meine Aufgabe in der Vorbereitung des Aufbaus der meteorologischen Stationen und der Durchführung einiger Messungen der Eisdicke.

Schwer bepackt ... nicht nur der LKW.

Eine sichere Route wurde vom Fernerkundler Thomas Krumpen (Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven, AWI) und dem Geologen Jens Hölemann (AWI) mit Hilfe von Satellitenbilder ausgespäht und uns in unserem GPS als Route zur Verfügung gestellt. Hinzu kamen natürlich weitere Sicherheitsmaßnahmen wie Satellitentelefon und Notfallausrüstung. Auch der regelmäßige Kontakt mit der Expeditionsleitung sorgte für ein sicheres Gefühl während der ganzen Tour. Einerseits dienten die Telefonate zur wissenschaftlichen Beratung, andererseits aber auch, um sicherzustellen, dass man in Tiksi weiß, wo das Team ist und ob es Hilfe benötigt.

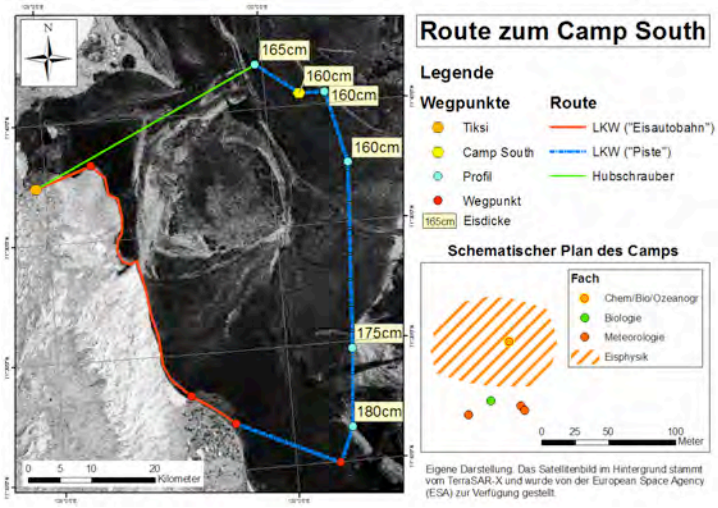
Mit an Bord waren der Biologe und Teamleiter Alexander Gukov (Lena-Delta-Reservat), Fahrer und Jäger Konstantin (Lena-Delta-Reservat), die Eisphysiker Leonid Panov (Institut für Arktis- und Antarktisforschung, Sankt Petersburg, AARI) und Igor Sheikin (AARI). Als fünfte Person war ich als Student der Umweltwissenschaften von der Universität Trier dabei.


Das Team (von links): Leonid, ich , Igor, Alexander und Konstantin.

2. Unterwegs

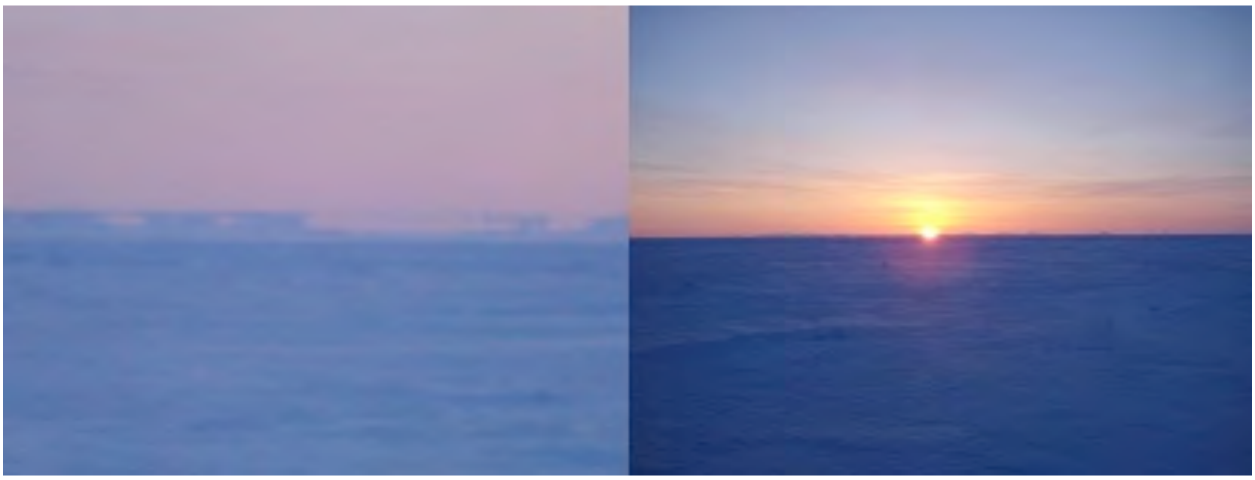
Am Sonntag, den 1.4.2012, fuhren wir um 8:30 Uhr unter blauem Himmel los. Die ersten zwei bis drei Stunden führten uns südwärts über eine Art Eisautobahn, die von Einheimischen als Verbindung zwischen verschiedenen Ortschaften genutzt wird. Natürlich ist das keine Autobahn im klassischen Sinne, aber verhältnismäßig gut und einfach zu befahren (mit bis zu 60 km/h). Der

Schlenker nach Süden war nötig, um einige Eisrücken zu umfahren, die selbst einem so kräftigen LKW Probleme machen können. Als wir dann die glatte Piste verließen, ging es sozusagen über die Landstraße weiter. Zwar immer noch recht glatt, aber schon mit einigen Schneeverwehungen, die nicht ganz so einfach zu passieren waren. Hier ging es auch nur noch mit max. 15-20 km/h voran ... meist eher langsamer. Es wurde einige Male die Eisdicke gemessen ... immerhin ist man mit schwerem Gerät unterwegs und da will man schon wissen, ob das Eis auch stark genug ist, um die Last zu tragen. Unter dem Eis ist ja der Ozean, und schwimmfähig ist der LKW nun auch wieder nicht. Unsere Messungen lagen immer über 150 cm Eisdicke und somit in einem sicheren Bereich. Um zurück in unserem Arbeitsgebiet zu kommen, ging es dann wieder drei Stunden nach Norden. Dort angekommen haben wir eine für die Experimente günstige Stelle gesucht und dann den Daheimgeblieben Ankunft und Position gemeldet. Die Eisdicke betrug 170 cm und es waren -20°C Lufttemperatur.



Route von Tiksi zum Camp South und der Lageplan des Camps.

Mit den ersten Arbeiten wurde begonnen, und in der Ferne gab es erst einige Luftspiegelungen zu bewundern und später einen schönen Sonnenuntergang. Luftspiegelungen sind an große vertikale Temperaturgradienten in der bodennahen Luftschicht gebunden. In diesem Fall kühlte die Schneeoberfläche sehr stark aus und die Lufttemperatur nahm mit der Höhe zu. Dies war mit einer entsprechenden starken vertikalen Änderung der Luftdichte verbunden. Die Lichtstrahlen verlaufen nun in gekrümmten Bahnen. Dadurch werden entfernte Objekte unter einem anderen Blickwinkel wahrgenommen.


Im Bild links: Der durch Luftspiegelung veränderte Verlauf der Horizontlinie. Rechts der Sonnenuntergang am ersten Abend.

Gegen Mitternacht ging es dann ins Bett. Im Wohnteil des LKWs hatten vier von uns Platz. Konstantin, unser Fahrer, hatte sein „Einzelzimmer“ im Führerhäuschen. Geschätzt war die Wohnfläche 2,5x3 m, und die Betten waren so schmal, dass man sich nicht einfach mal umdrehen konnte. Einer unbedachten Bewegung im Schlaf wäre unweigerlich ein Sturz auf den

Frühstückstisch gefolgt ... Frühstück im Bett sozusagen. Trotz dieses Risikos und des die ganze Nacht durchlaufenden Motors (um es in der Kabine warm zu halten) haben all gut geschlafen, und am nächsten Tag ging es um 6.30 Uhr los.

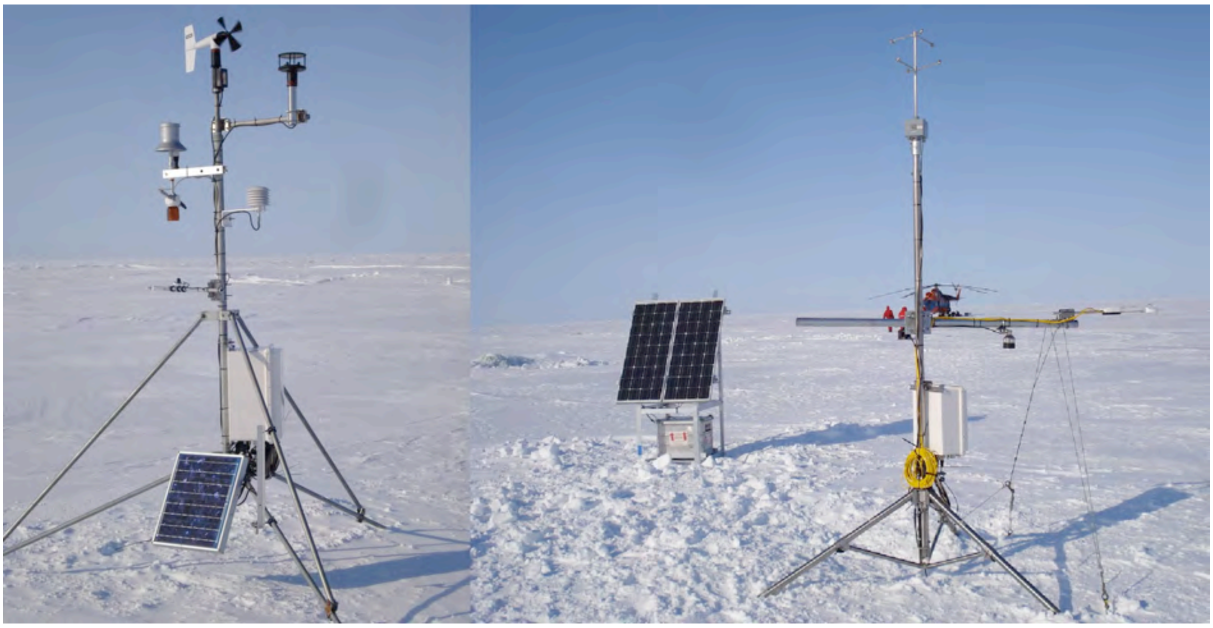
Unser Wohn- und Schlafzimmer.

3. Leben im Camp South

Am zweiten Tag ging jeder erst mal seinen eigenen Aufgaben nach. Alexander bereitete die biologischen Experimente vor und baute netterweise ein Klohäuschen ... naja ... mehr einen Windschutz. Aber sehr hilfreich ...

Das Klohäuschchen.

Igor und Leonid begannen mit ihren Vorbereitungen, und ich baute die Grundgerüste für die zwei Wetterstationen und unser kleines Kraftwerk auf. Letzteres bestand aus zwei Solar-Paneelen und einer Batterie zur Versorgung der Station für Messungen von Temperatur, Wind und verschiedener Strahlungsterme. Die zweite Station misst zusätzlich weitere Parameter wie Feuchte und Oberflächentemperatur. Redundante Messungen einiger Größen sind wichtig, da immer mal ein Sensor ausfallen kann. Oder, wie vor einigen Jahren geschehen, sich ein Eisbär als Hobbymeteorologe versucht und dabei leider nicht alles ganz funktionsfähig zurückgelässt. Seitdem werden die Stationen mit Diesel eingerieben. Laut den Einheimischen soll das ganz gut helfen. Gegen akuten Eisbär-Besuch war Konstantin, der neben seiner Tätigkeit als Fahrer auch Jäger ist, mit einem Gewehr bewaffnet. Zuerst hätten wir uns allerdings in den LKW zurückgezogen ... man möchte ja als Polarforscher Knut möglichst in Ruhe lassen. Immerhin sind wir in seinem Lebensraum ... überlegen Sie mal, bei Ihnen würde jemand im Garten stehen, und wenn Sie gucken, was der da so treibt, fängt der auch noch an zu schießen ... glücklicherweise kam es aber zu keinerlei Zwischenfall.



Links: Automatische Wetterstation. Rechts: Strahlungsstation und Energieversorgung. Das Bild entstand am Mittwoch, dem 4. April 2012. Im Hintergrund ist der Hubschrauber zu sehen, mit dem der Rest der Expedition einflog.

Der erste Arbeitstag ging recht erfolgreich zu Ende, und es gab wieder einen tollen Abendhimmel. Eines der Instrumente wurde als Teleskop umfunktioniert, und wir konnten einen 3/4-Mond betrachten.

Leider hatten wir in unserer Gruppe keine Sprache, die von allen gemeinsam gesprochen wurde. Deshalb habe ich teils auf Englisch, teils auf Deutsch geredet. Lediglich mit Konstantin konnte ich mich kaum unterhalten, da er nur Russisch spricht und ich leider nicht. Aber mit Händen, Füßen und einigen Geräuschen ging auch das. Oder einer der anderen hat

Es wurde bis spät abends gearbeitet, aber vor solch einer Kulisse vergisst man für uns übersetzt. Es herrschte eine lockere Atmosphäre und die Herzlichkeit der Russen hat mich beeindruckt.

Ursprünglich war geplant, dass der Hubschrauber mit dem Rest der Truppe schon am Dienstag kommt, aber wie das auf Expeditionen nun mal so ist, kommt immer alles anders. Deshalb war mein Arbeitstag teils damit gefüllt, dass ich die anderen bei ihren Tests unterstützt habe, teils mit dem Schmelzen von Schnee zur Trinkwasserversorgung beschäftigt war und teils auch einfach im warmen LKW sitzen konnte, um ein wenig Musik zu hören und es einfach mal zu genießen, an was für einem so besonderen Ort man gerade ist.

4. Geburtstag auf dem Eis

Mittwoch war dann noch einmal volles Programm. Heidi hat beim allmorgendlichen Telefonat Eisbohrkerne bestellt, die wir von Hand ziehen mussten. Da das ein Weilchen dauert und auch einiges an Muskelkraft kostet, haben Sasha Gukov und ich gleich nach dem Frühstück damit angefangen. Als der zweite Kern fast fertig gebohrt war, kam der Hubschrauber eingeschwebt. Nachdem ich einige Geburtstagsglückwünsche entgegen nehmen durfte, folgten dann weitere Experimente und die Endmontage der Wetterstationen. Insgesamt eine ansehnliche Station mit vertretener Geochemie, Biologie, Meteorologie, Ozeanographie und Eisphysik. Da der LKW schon etwas früher losfahren musste (um noch im Hellen zurück in Tiksi zu sein) und Professor Alfred Helbig mich noch für die letzten Handgriffe an den Wetterstationen gebraucht hat, konnte ich mit dem Hubschrauber zurückfliegen. Da anstatt sechs bis sieben Stunden im LKW nur ca. 30 Minuten im Hubschrauber zu verbringen waren, konnte ich mir das schönste Geburtstagsgeschenk schon vor den anderen erfüllen: Nach vier Tagen endlich eine heiße Dusche!

Eisphysiker am Werk. Links beim Vermessen von dynamischer Eisveränderung durch Druckbelastung (hier durch den LKW). Rechts wird ein Eisbohrkern vermessen und für Labortests vorbereitet.

Aufs Eis mit Russen? Immer wieder gerne!
Daniel

Tiksi, 10. April 2012

Flugfreie Woche

Nachdem alle Stationen ein erstes Mal angeflogen wurden, stand nun schließlich eine Woche ohne Flüge auf das Eis an. Das ist für einige Teilnehmer in erster Linie natürlich eine willkommene Erholungspause und eine Möglichkeit, mitgebrachte Arbeit zu erledigen. Wenn man davon aber genug hat, bedarf es in Tiksi ein wenig Kreativität, sich zu beschäftigen, da dieser Ort nicht sehr reich an Kinos, Sportstätten oder sonstigem ist. Also machten sich ein paar Teilnehmer der Expedition auf den Weg, die Gegend um Tiksi etwas zu erkunden.

Unser Ziel war eine kleine Insel, die ca. 7 km entfernt liegt und von Tiksi aus zu sehen ist. Nach etwa zwei Stunden Fußmarsch bei wunderbarem Wetter (Sonnenschein, -20°C) über das Eis der Bucht von Tiksi hatten wir eine Sandbank kurz vor der Insel erreicht. Auf dieser Sandbank liegen etwa fünf bis zehn alte Schiffe, die dort seit über 60 Jahren vor sich hin rosten. Es war ein richtiges Abenteuer, diese Schiffe von innen und außen zu erkunden, wenn die riesigen Schneewehen es denn überhaupt ermöglichten.

Bei wunderbarem Wetter, aber eiskalten Temperaturen über das verschneite Eis der Bucht von Tiksi.

Nachdem wir schließlich auf fast jedem Schiff herumgeklettert waren sowie noch ein paar alte Flugzeuge (oder das, was davon übrig geblieben ist) auf der Insel entdeckt hatten, ging es auf den Rückweg.

So lässt sich die willkommene Freizeit in Tiksi wirklich gut aushalten.

In diesem Sinne beste Grüße im Namen aller Expeditionsteilnehmer,

Lera, Torben, Thomas und Bennet

Torben Klagge (GEOMAR) und Valeria Selyuzhenok (Doktorandin, AWI) sind dabei, eines der Schiffe genauer zu erkunden.

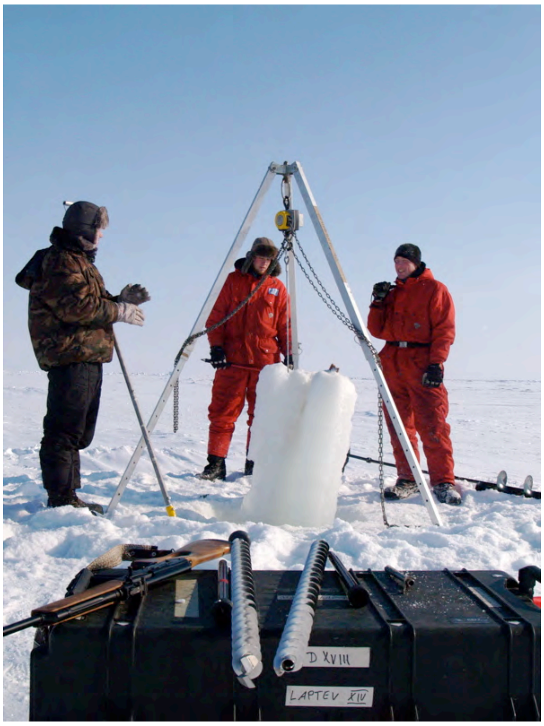
Beeindruckender „Schiffsfriedhof“ auf einer Sandbank nahe Tiksi.

Tiksi, 12.04.2012

Ozeanographische Verankerung erfolgreich geborgen

Die Verankerung „Central station“ mit vier CTDs und einem akustischem Strömungsmesser hatten wir am Anfang der Expedition im Festeis ca. 60 km östlich des Lena-Deltas verankert. Insgesamt hat die Messkette 16 Tage (im Sekundentakt) Meeresströmungen sowie Veränderung der Dichteverteilung in der Wassersäule registriert. Ein Ziel dieser Messungen ist es herauszufinden, welchen Einfluss Stürme auf die Wassersäule unterhalb der fast zwei Meter mächtigen Festeisdecke haben.

Gestützt durch den Umweltsatelliten „Envisat“ haben unsere Felduntersuchungen gezeigt, dass das Festeis im Gebiet von Station „Central“ vor vier Monaten in Küstennähe gebildet wurde und danach nach Osten ins tiefere Wasser getrieben ist. Die Kinderstube des Eises hat deutliche Spuren hinterlassen, denn die oberen 70 cm des Festeises sind durchzogen von Schichten mit Sedimenteinschlüssen, es ist sogenanntes schmutziges Meereis. Die Bildung und der Transport von schmutzigem Meereis sind ein wichtiger Prozess für den Sedimenttransport im Nordpolarmeer.



Geborgen ... Nach schweißtreibenden Stunden und acht Eislöchern, jedes etwa 160 cm tief, konnte die Verankerung „Central station“ am Donnerstag erfolgreich geborgen werden.

Schmutziges Meereis in Eiskernen der östlichen Laptev-See.

Tiksi, 16. April 2012

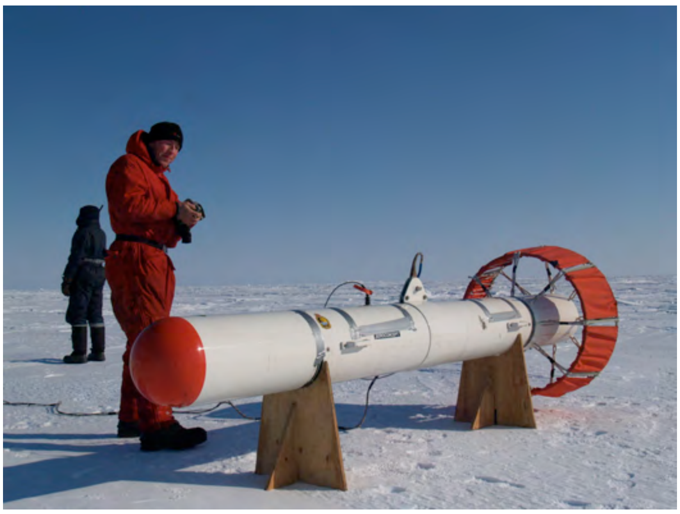
Heute bekam die Expedition Besuch von der deutschen Botschaft in Moskau. Der Ständige Vertreter des Botschafters der Bundesrepublik Deutschland, Herr Dr. Birgelen, Frau Birgelen und der Leiter des Referats für Wissenschaft und Bildung der Botschaft, Herr Heinz, werden die Expedition vier Tage begleiten, um sich vor Ort ein Bild über die bilaterale Kooperation im Bereich der Polar- und Meeresforschung zu machen. Schon am ersten Tag nach der Ankunft in Tiksi wurden die Gäste in die Stationsarbeiten einbezogen und mussten der Expedition auf das Festeis nahe der Polynja folgen.

Gleich geht es aufs Eis. Herr Dr. Birgelen (rechts), Frau Birgelen und Herr Heinz nach dem Frühstück vor der „Expeditionskantine“. Im Restaurant „Sever“ werden alle Expeditionsteilnehmer morgens und abends bestens verköstigt.

Tiksi, 21. April 2012

Auf dünnem Eis: Am Freitag, dem 20.04. fand der seit langem geplante Eisdickenmessflug über dem Packeis nördlich der Festeiskante statt. Die Eisdicke lässt sich mit dem BIRD, einem Instrument, das vom Helikopter in etwa 15 m Höhe über die Eisoberfläche geschleppt wird, ermitteln.

Perfekte Wetterbedingungen, d.h. geringe Windgeschwindigkeiten und blauer Himmel, ermöglichten uns einen 150 km langen Flug nach Norden und zurück. Das gemessene Eis war im Vergleich zu früheren Messungen überraschend dünn (30 bis 50 cm). Ein Indiz für hohe Eisproduktionsraten in den Monaten davor. Die Messdaten sollen nun zur Verbesserung von Satellitendaten und Klimamodellen beitragen.



Torben Klagge bereitet den BIRD für den Einsatz vor.

Eisdickenmessgerät (BIRD) 15 m über dem Festeis der Laptev-See im Einsatz.

Tiksi, 22. April 2012

Rückkehr zum Camp South

Nachdem wir Anfang April die Wetterstationen am Camp South installiert hatten, war es nun an der Zeit, die Geräte vom Eis zu holen. Die Wetterstationen hatten 24 Stunden durchgemessen, also sollte ein schöner Datensatz mit einer kurzen, aber interessanten Zeitreihe auf uns warten. Da für die ganze Woche das Wetter als eher mäßig angekündigt war, hatten wir uns auf einen kalten, windigen Tag auf dem Eis vorbereitet. Aber das Tiefdruckgebiet machte sich schneller als gedacht aus dem Staub und es

Ganz entblößt: Die Strahlungsstation ohne Sensoren.

war sonnig und gefühlt warm. Natürlich war es deutlich unter 0°C, aber mit der dicken Polarkleidung war es dann doch wirklich angenehm.

Dank der guten Teamarbeit lief der Abbau lief wie am Schnürchen. An der Stelle nochmal vielen Dank an Valeriya Selyuzhenok (AWI), Sergei Kirillov (AARI) und Viktor Vizitov (AARI) für die vielen helfenden Hände. Dadurch konnten Alfred Helbig und ich (Universität Trier) die drei Stationen in weniger als zwei Stunden abbauen. Auch die übrigen Arbeiten wurden zügig durchgeführt, und die geplanten vier Stunden auf dem Eis wurden auf etwa 2 ½ verkürzt.

Ein wenig wehmütig stiegen wir schon in den Hubschrauber, da es für die meisten von uns der letzte Flug während dieser Expedition war. In wenigen Tagen und nach viel Packerei geht es dann wieder zurück in die Heimat. Auf Wiedersehen, Tiksi.

Daniel

Tiksi, 23. April 2012

Die letzten zwei Tage wurde nur noch gepackt und das bei strahlendem Sonnenschein, den wir seit Anfang der Expedition fast durchgehend haben. Insgesamt 3 Tonnen Fracht warten jetzt auf den Rücktransport nach Sankt Petersburg und Deutschland.

Wir sind jetzt auf dem Weg zum Flughafen und in ca. 2 Stunden geht es in Richtung Süden nach Jakutsk. Hier werden wir einen Zwischenstop einlegen und morgen früh gegen 10:00 weiter nach Moskau fliegen.

Gut gelaunt freuen wir uns auf den Frühling in Deutschland.

Tschüss Tiksi, hallo Deutschland

Die Expeditionsteilnehmer in Tiksi (Sonne bei -12°C).

Letter from the Head of the Department of Sciences and Education of the German Embassy in Moscow

Botschaft
der Bundesrepublik Deutschland
Moskau

119 285 Moskau, Uliza Mosfilmowskaja 56

An Fr. Dr. Heidemarie Kassens
Leibniz-Institut für Meereswissenschaften
IFM-GEOMAR
Gebäude Ostufer
Wischhofstr. 1-3, Geb. 4, Raum 329
D-24148 Kiel

Fax: +49 431 600 2961 o. 600 132850

Nachrichtlich:
An Direktor des GEOMAR
Herrn Prof. Dr. Peter Herzig
Leibniz-Institut für Meereswissenschaften
IFM-GEOMAR
Gebäude Ostufer, Wischhofstrasse 1-3
24148 Kiel
Fax: +49 431-600-2805

HAUSANSCHRIFT
119 285 Moskau
Uliza Mosfilmowskaja 56
Russische Föderation

INTERNET: www.moskau.diplo.de

TEL + 7-499-938-28-85
FAX + 7-499-938-2880

Bearbeitet von
Karsten Heinz

Karsten.Heinz@diplo.de

Moskau, 24.04.2012

Sehr geehrte Frau Dr. Kassens,

für Ihren gastfreundlichen und herzlichen Empfang und die Begleitung in Tiksi möchte ich mich ganz herzlich, auch im Namen des Ständigen Vertreters, Dr. Georg Birgelen, bei Ihnen und den Mitgliedern der deutsch-russischen Forschungsexpedition in der Laptewsee bedanken. Wir haben uns von der vertrauensvollen Zusammenarbeit der Wissenschaftler überzeugen können. Nicht nur die Ergebnisse Ihrer Expedition sind wichtig, sondern auch die dauerhaft gute Zusammenarbeit mit den russischen Kollegen. Die Polarforschungsexpeditionen und das Otto-Schmidt-Labor in St. Petersburg sind dafür beispielgebend, auch für andere Forschungsbereiche. Sowohl die Expeditionen als auch die Arbeit des Labores belegen sehr deutlich, dass es gelingen kann, attraktive Bedingungen auch für deutsche junge Wissenschaftler in Russland zu schaffen, um eine ausgewogene Balance der Kooperation zu erzielen. Dies führt dann auch zu steigendem russischen Kooperationsinteresse. Ich habe dies auch bei einem Gespräch im Zuge der Evaluierung der HGF-Vertretung in Moskau gegenüber der deutschen Expertenkommission unter Vorsitz von Prof. Hüttl am 26. April 2012 in Moskau deutlich gemacht.

Ich bin mit vielen neuen Eindrücken aus Tiksi und Jakutsk nach Moskau zurückgekehrt und bin sicher, dass wir die bilaterale wissenschaftliche Zusammenarbeit mit der Republik Sacha ausweiten können. Zahlreiche Anregungen, insbesondere zum Ausbau der Forschungskooperation mit der Ammossow-Universität und dem Permafrostinstitut Jakutsk auf dem Gebiet der Meeres- und Polarforschung, habe ich bereits an das Bundesministerium für Bildung und Forschung übermittelt. Eine Kopie unseres Berichts wird Ihnen zugehen. Die Deutsche Botschaft steht gern als Ansprechpartner zur Verfügung, um diese Projekte voranzutreiben.

Für Ihre Arbeit wünsche ich Ihnen weiterhin alles Gute und viel Erfolg.

Mit freundlichen Grüßen

Karsten Heinz

Botschaftsrat
Leiters des Referats für Wissenschaft und Bildung